Essays on Industrial Organization: Regulatory Uncertainty and Dynamic Decision-Making by Firms

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Business Administration)
in The University of Michigan
2010

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regulatory
uncertainty
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ACKNOWLEDGEMENTS

This work has benefited greatly from conversations with Francine Lafontaine, Uday Rajan, Tom Lyon, and Brian McCall, as well as other colleagues at and visitors to the University of Michigan.

In addition, I am grateful to Anne Fleischer for her encouragement and willingness to act as first reader, Nick Powers for keeping me company (and sane) on this journey, my family for tolerating my (increasing?) penchant for sophistry, and, most especially, Kathryn Haraminac for her patience and support throughout this process.

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CHAPTER I

Introduction

This dissertation is composed of three papers concerned with how firms respond to uncertainty and dynamic interactions. These are areas that have long been important research topics among industrial economists. The justification for this is obvious: the course of events is rarely deterministic, and the past often exerts a marked influence on present decisions. Both factors lead actors to adopt very different strategies from what they would do in a deterministic, one-shot world. Below, I provide a short summary of each paper, describing how I extend and contribute to this rich literature.

In my first paper, I consider how uncertainty stemming from unstable regulatory regimes affects the boundaries of the firm. I present a simple theoretical model based on the idea that more unstable regulatory regimes increase the expected costs of both equity investment and trusting valuable intangible assets to outsiders. I test the predictions of the model using data on the organizational form decisions of a major international hotel firm. These data are ideal, because hotel properties can be operated in three different ways:

- a highly centralized form in which the central firm takes a large equity stake and retains operational control;
- an arms length arrangement in which the central firm relinquishes operational control to an outsider who takes all of the equity risk; and

- a hybrid form in which the central firm reduces its equity exposure but maintains operational control.

Multinomial logit estimates strongly support the prediction of the theoretical model that as regulatory stability decreases greater use is made of the hybrid form. Overall, the paper extends recent work on the implications of institutional quality, showing that they affect decision-making for retail businesses in addition to the high-tech and manufacturing industries that have been the focus of much of the past literature.

My second paper continues to focus on issues relating to an uncertain regulatory environment, but it also incorporates strategic uncertainty. In other words, I consider markets where firms must factor in the behavior of their competitors when making decisions. Using a model of dynamic competition between capacity constrained oligopolists, I consider how the presence of exogenous uncertainty about the arrival time of a more stringent regulatory regime affects the intensity of competition relative to a world where the regulatory trajectory is fully deterministic. I find that exogenous uncertainty about the regulatory future sometimes leads to the reverse of the standard "real options" prediction of lower investment in uncertain environments. In other words, sometimes uncertainty leads to more investment. The lack of a clear comparative static for uncertainty in part can be attributed to the nature of the uncertainty, but it also reflects an interaction with the firms' strategic incentives. Moreover, my model shows that the differences in investment spending translate to significant differences in total welfare. I believe my theoretical results have interesting implications both for the design of regulatory policy and expectations about firm and consumer behavior in a variety of contexts.

In my third paper, I reconcile ambiguities in the previous empirical work on spatial preemption with the strong predictions offered by theory. I develop a game-theoretic model that shows that incorporating the stylized facts of consumer heterogeneity and brand awareness can help explain the heterogeneity of the past empirical evidence.

The model shows that as products' brand affiliations increase in importance to consumers, preemption becomes less credible. I empirically test the implications of the model using data on the lodging industry, which is the type of industry where one might expect preemption, but one that is also characterized by high brand-values. Consistent with my model, I find that incumbent lodging companies do not deter entry; however, they do mitigate intra-brand cannibalization through the development of sub-brands.

CHAPTER II

The Effect of Regulatory Stability on Organizational Form Decisions: Evidence from Within the Firm[1]

2.1 Introduction

The effect of institutions on economy-wide growth and performance has long attracted attention from economists (c.f. North and Thomas (1976), Acemoglu et al. (2001), Dixit (2009)). More recently, a small but growing literature has considered the effect of institutions at a more micro level, often by examining how multinational corporations adapt to different local market conditions. This literature has explored, among other things, how political and regulatory institutions affect the level of foreign investment (c.f. Levy and Spiller (1994), Henisz and Zelner (2001), Smarzynska and Wei (2002)) as well as the different forms of investments (c.f. Oxley (1999), Asiedu and Esfahani (2001), Uhlenbruck et al. (2006)). This micro-level literature has been concerned almost exclusively with high-tech and manufacturing industries. There are many reasons to expect, however, that institutional quality also affects the service sector, which accounts for an increasingly large amount of global economic

[1]This paper is joint work with Francine Lafontaine of the University of Michigan and Rozenn Perrigot of the University of Rennes 1.

activity. In fact, one important feature of many retail and service sector industries is that firms can access customers in other countries only by being present locally, which requires investing in these markets. In other words, contrary to what occurs with manufacturing, there is no option of exporting from more desirable locations to protect investments for firms in the service and retail sectors.

In this paper, we examine how firms in the lodging industry, which among retail and service firms are particularly susceptible to the types of expropriation and hold-up problems emphasized in this literature, organize their operations to maximize their returns from affiliated properties. Lodging firms historically have relied on three different forms of organization - franchising, company ownership, and management contracts - each of which has its own equity and control implications.[2] The existence of all three modes provides flexibility in adjusting to different local market circumstances. In particular, as we argue further below, the reliance on management contracts, in addition to the more standard options of franchising and company ownership, gives lodging firms the opportunity to protect themselves against the risks of hold-up while also protecting the value of their intangible assets.

We develop a simple model that emphasizes how variation in organizational form decisions allows firms to protect themselves against unstable regulatory environments. We then test the predictions from our model using a unique, proprietary dataset with information on the organizational forms of all the international hotels affiliated with a major multinational, multi-brand lodging company. A confidentiality agreement prohibits us from disclosing the name of the company or any specific characteristic that might lead to its identification. For this reason, we refer to it as the Company, keeping all references to its operations and brands oblique.

Our empirical analyses show that the Company eschews ownership in markets where the regulatory regime is less stable. Rather than turning over operational

[2]We use the term franchise to mean master franchising and sub-franchise agreements as well as direct franchising.

control to local partners, as would occur under franchising, however, the Company maintains operational control by using management contracts. We interpret our findings as evidence that in unstable regulatory environments, the Company not only faces potential risks of expropriation, but also difficulties in enforcing the type of contracts that franchising depends upon. This in turn leads to important free-riding risks under franchising. As a result, the firm chooses to maintain direct control and not expose its brand value to the whims of the local hotel owners in markets with unstable regulatory regimes.

The paper proceeds as follows. In Section 2, we describe the international lodging industry, discuss how organizational form decisions in this industry relate to regulatory stability, and present our model. In Section 3, we describe the empirical approach and the data. We discuss our results in Section 4, and conclude in Section 5.

2.2 Organizational Form and the Regulatory Environment

2.2.1 Organizational Forms in the Lodging Industry

While most retail and service firms either operate their own properties locally or rely on franchisees who own and operate the business, a hotel affiliated with a multi-hotel brand can be operated under either of these two organizational forms or a third one, called a management contract. These three mutually exclusive organizational forms differ along two important dimensions: equity involvement for the Company, and the extent to which the firm retains operational control. The three organizational forms are as follows:

Company owned and operated The Company is the equity owner and full residual claimant. A hotel's managers are employees of the Company. The compensation of these employees may contain some incentive payments, but the contracts are low-powered compared to

those of franchisees, who are residual claimants (see below). More precisely, the incentives of the hired managers are more closely tied to promotion within the firm (i.e. to manage better/higher revenue hotels, or move up the hierarchy) than to local operations.

Management contracts In this case, the hotel is owned by a group of investors that are usually local to the market in which the hotel is located. These hotel owners contract with the Company to run the hotel under one of its brands. The Company then hires the hotel managers and exercises the same control over local operations as when the hotel is company-owned and operated. The Company receives contractually agreed upon management fees in exchange for these services. These fees are normally a percentage of the hotel's gross revenues, sometimes supplemented by guaranteed annual minimum or lump-sum payments (c.f. Kehoe (1996), Contractor and Kundu (1998b)). Note that management contracts are long term, lasting up to, and sometimes beyond, 10 years. Finally, since the hotel managers are employees of the Company, the incentives of the managers under this contractual form again are more closely tied to promotion within the firm (to manage better/higher revenue hotels, or move up the hierarchy) than to local operations.

Franchised In this case, the hotel is owned and operated by a franchisee, who may be an individual, a small group, or even a company, who pays fees to the Company in exchange for the rights to operate under the brand name. After paying upfront franchise fees and percentage royalties on sales to the Company, the franchisee is the full residual claimant. In that sense the franchise contract gives franchisees strong incentives to put forth effort and maximize the profits generated

by the hotel. The contracts also specify operations guidelines that ensure that the hotel meets the Company's requirements. As noted in the literature on franchising, at times the incentives to maximize local profits can lead to behaviors that are detrimental to the brand. The operations guidelines are meant to protect the Company against such behaviors and resulting costs. We discuss these issues further below. Note that franchise contracts are also long term, with the average contract in 2001 lasting more than 16 years in this industry according to Blair and Lafontaine (2005).

We argue the capacity to choose among these different organizational forms for each of their hotels gives firms in the lodging industry flexibility in how they respond to incentive issues and market characteristics, including regulatory stability. Table 2.1 summarizes the equity position of the Company and its control over local operations for each organizational form. As the table indicates, the organizational form choices available to the Company entail different combinations of two distinct characteristics. Hence, the organizational forms cannot be ordered monotonically along a single dimension.

Table 2.1: Company Control and Equity Involvement Under Different Organizational Forms

		Direct Control Over Operations:	
		No	Yes
Equity Involvement:	No	F	M
	Yes		C

Notes: 'C' indicates company ownership; 'M' indicates management contracts; 'F' indicates franchising.

2.2.2 Regulatory Stability and Equity

Authors have argued and shown empirically that institutional stability is one of the most important institutional characteristics (c.f. Wei (1997), Wei and Shleifer (2000), Henisz and Zelner (2001)) affecting firm investment decisions. The intuition is straightforward: in countries with more unstable regulatory environments, i.e. those where there are fewer checks on bureaucratic and regulatory authority, it is harder for policy-makers to credibly promise not to hold-up investors.

The empirical literature on the effect of regulatory stability on firm decisions has focused mostly on manufacturing firms, but the lodging industry is perhaps even more susceptible to problems of expropriation and hold-up. This is because manufacturers often can choose to locate outside more problematic markets and rely on exports to serve such markets. Firms in the lodging industry, in contrast, must have a physical presence if they are to serve a given market. This, combined with the relative lack of alternative uses for their assets, makes the hospitality industry especially vulnerable to potential ex-post policy or regulatory changes. Moreover, much like the telecommunications, manufacturing and energy industries that have been the mainstay of the literature on the economic impact of institutional quality on firm behavior and performance (e.g. Henisz and Zelner (2001), Smarzynska and Wei (2002), Gutierrez (2003)), the lodging industry is characterized by large up-front capital investments. In the case of large resorts, these may be as much as $100 million (Contractor and Kundu (1998a)).[3]

Also similar to heavy industries, hotel firms are susceptible to government intervention and hold-up problems after construction. While cases of outright asset expropriation have been uncommon for this industry, the international business press contains many stories about sudden changes in the regulation of hotels and other in-

[3]Super-premium properties may cost even more. For example, the recently constructed Wynn Las Vegas is reported to have cost $2.7 billion. MIN Media Industry Newsletter, "Las Vegas Gets the "Maxim"-um," 58(21), May 23, 2005.

ternational service industries. For example, in June 2006, the United Arab Emirates' Economic Department decreed that all hotels and hotel apartments were required to obtain licenses to "serve alcohol, and open bars, nightclubs and restaurants which show artistic programmes."[4] Similarly, the Venezuelan government recently forced the temporary closure of 118 of 132 McDonalds franchises, accusing the company of accounting irregularities. Coming on the heels of a similar move against another American multinational, the government's actions have been perceived as political maneuvering by President Hugo Chavez rather than evidence that the fast-food retailer was evading taxes.[5]

These types of unanticipated changes in the regulatory environment can have profound impacts on the value of operations in affected markets. The annual reports of major hotel brand operators like Marriott and Accor explicitly mention political risk, economic volatility, and/or the impact of regulatory changes in their discussion of strategy and financial outlook. For example, Marriott's list of factors affecting future performance includes "international, national and regional economic and geopolitical conditions."[6] Meanwhile, a 2005 letter to investors from Accor's CEO notes that the company is looking to "assume greater risk in emerging markets as [those countries'] economic and political environment improves." The Accor Annual Report also contains a table describing the challenges to sustainable growth, which includes "risks of corruption."[7]

The vulnerability of the industry to expropriation leads to our expectation that the Company will opt for high equity stakes - company operations - only in those markets where such holdings are relatively safe. In more volatile environments, we expect it to rely instead on non-equity forms. But why would outside investors expose themselves

[4]Nasouh Nazzal, "New Rules Issued to Regulate Hotel Sector," *Gulf News*, June 26, 2006.

[5]Ian James, "Venezuela Tax Agency Closes McDonalds Temporarily," *Associated Press*, October 10, 2008; *All Headline News*, "Venezuela Orders Closure of 115 McDonalds Outlets for 48 Hours," October 10, 2008.

[6]Marriott, *Annual Report 2005*, p. 11.

[7]Accor, *Annual Report 2005*, p. 13, 106.

to owning properties that the lodging company itself finds too risky to hold? The answer, we believe, lies in the nature of the risks and the type of investors involved. The trade literature suggests that these investors tend to be local business people who are better able to manage risks stemming from the regulatory environment by virtue of their knowledge of the local market, and/or close personal connections to the government. For example, on May 26, 2009, Marriott signed an agreement to manage a luxury hotel property owned by Emirates Airline and Group, the largest aviation and travel services provider in the Middle East. The chief executive of Emirates Airline and Group is His Highness Sheikh Ahmed bin Saeed Al-Maktoum, a member of the United Arab Emirates royal family.[8] Similarly, franchisees - including master franchisees and area developers - are most often local business people well versed in the characteristics of their local markets. In that sense, both management and franchise contracts represent efficient solutions in which a certain form of risk is allocated to parties best able to bear it.

In sum, we expect regulatory stability to be associated with an increased reliance on company ownership, the only form of organization in this industry that entails an equity stake for the Company. Whether the Company chooses to franchise or operate under management contracts in countries with less stable regulatory environments, however, is unclear from the arguments above. And indeed, we expect this decision to rely on other factors, to which we now turn.

2.2.3 Incentives and Control

In the context of an industry - like lodging - where firms operate chains of properties, the physical distance between headquarters and local operations makes it difficult to observe the behavior of employees. The agency-theoretic solution to this problem is that the firm should devise a high-powered incentive contract for its local managers.

[8] *Travelwires*, "Emirates awards hotel contract to Marriott International," May 26, 2009.

This, in fact, is what franchising achieves: by making the local operator a residual claimant, the firm obtains higher effort from its managers, and thus greater levels of output (profits) locally. This solution is expected to be especially valuable when local effort has a large impact on output, and when it is particularly difficult to observe and evaluate the provision of such effort.[9]

While franchising a property addresses the local effort, or "incentive to shirk" problem, it creates another type of incentive problem. As residual claimants, franchisees bear the full cost of maintaining quality in their local property and abiding by company policies valued by customers, but because they operate under a common brand, they share the benefits of these behaviors with other franchisees. This is expected to lead franchisees to underinvest in such activities, and more generally free-ride on the value of the brand.[10] As noted by Brickley and Dark (1987) and Brickley (1999), free-riding on the brand is especially likely to be a problem in non-repeat industries such as lodging, where customers cannot discipline local operators because they do not usually frequent the same property repeatedly.

According to Brickley (1999) and Lafontaine and Raynaud (2002), franchisors address this problem of franchisee free-riding by including a number of clauses in their contracts that impose constraints on the behavior of franchisees. Examples of such clauses include specific operations procedures, input sourcing requirements, and minimum advertising requirements. Whether or not the franchisee abides by these rules is assumed observable to the franchisor, and the franchisee who is found in violation of such rules can be terminated on this basis. Combined with franchisee rents from local operations, these rules and the opportunity to terminate non-complying franchisees yield a self-enforcement mechanism. In other words, the franchisee who

[9]See e.g. Lafontaine (1992) and Lafontaine and Slade (2007) for a review of the empirical literature on this topic. See also Bradach (1998) on the differences in incentive systems for company operated and franchised properties.

[10]See notably Brickley and Dark (1987), Blair and Kaserman (1994), and Lafontaine and Raynaud (2002).

wishes to continue to earn the rents associated with being affiliated with the brand abides by the requirements in the contract and does not free-ride.

The self-enforcing aspect of franchise contracts, however, depends critically on the capacity of the franchisor to verify various aspects of local operations that are explicitly constrained via contract. It also requires that non-complying franchisees can be identified and punished. In environments where the regulatory context is less stable, the conditions necessary to support contract enforcement may not be satisfied.[11] In particular, changes in the perceived probability that a franchisor will be able to terminate a misbehaving franchisee, or fear of such changes, makes reliance upon self-enforcement to resolve the franchisee free-riding problem problematic. Consistent with this argument, Brickley et al. (1991) find evidence that franchisors rely less on franchising in states in the United States that have enacted laws making it difficult to terminate a franchise contract. Concerns about the viability of termination as a way to discipline franchisees are likely to be even larger in an international context where objective appraisals of behavior may be difficult, and the impartiality of courts questionable.

The arguments above suggest that the Company may choose to address the problem of franchisee free-riding in markets characterized by limited opportunities to terminate or otherwise discipline misbehaving franchisees by having employees operate the property. As noted above, this can be accomplished either by keeping the property company-owned or by operating it under a management contract. Under either of these organizational forms, the employed manager's incentives are not tied so much to the hotel's profits, and so he/she gains little, or nothing, by increasing sales or profits locally at the expense of the brand. In fact, such employees stand to lose much by behaving in ways that damage the Company's brands, as they may lose

[11]Even in the United States, which typically ranks as a market whose regulatory environment is rather stable, franchisee termination can be problematic. See Blair and Lafontaine (2005) ch. 10, on this issue.

opportunities for promotion if this is discovered.

In those volatile markets where the Company partners with local investors on the grounds that they may have connections or knowledge that insulate their investments from expropriation risks, the firm may legitimately fear an even greater inability to discipline would-be franchisees in the event of a dispute over contract details. In such cases, we expect to see the Company turn to management contracts as a way to simultaneously address both the expropriation and control issues.

2.2.4 A Parsimonious Model of Organizational Form Decisions

We present a simple model that lays out the trade-offs described above and the main effects we expect to find in the data as a result. In each period, we assume that the Company chooses the organizational form f^* that, for each hotel i in country k at time t, maximizes the expected net present value of operating the property (i.e. $V_{ikt}^{f^*} \succeq V_{ikt}^{f} \ \forall \ f$).[12] The relative desirability of any given organizational form will depend on how the equity and control dimensions discussed above interact with the characteristics of the local market and the property.

Normalizing the returns to using a management contract to zero, the value functions for company ownership (C) and franchising (F) for a given property i in country k at time t can be written as:

$$V_{ikt}^{C} = R - B(s_i, \phi_{kt}) \tag{2.1}$$

$$V_{ikt}^{F} = G(m_{ikt}) - E(\phi_{kt}, s_i, d_{kt}), \tag{2.2}$$

respectively. In V_{ikt}^{C}, R is the value of the added flexibility that being the sole owner and operator affords the Company.[13] For simplicity, we assume R is the same for all

[12] We assume that the decision to have the property in the firm's portfolio has already been made. Similarly, we assume that the characteristics of the property are predetermined. This conditional approach is consistent with the majority of the literature in this area (c.f. Asiedu and Esfahani (2001)).

[13] To paraphrase an industry adage quoted in Bradach (1998, p. 2), R reflects the benefits of being

hotels.[14] $B(s_i, \phi_{kt})$, for its part, refers to the expected losses directly associated with the possibility that, during the expected life of the assets, the local government will enact rules that capture, or in some other way reduce, the future returns from the investment. We assume that these costs are increasing in the size of the hotel, s_i, and decreasing in the level of regulatory stability of the country, ϕ_{kt}.

In V^F_{ikt}, $G(m_{ik})$ is the benefit associated with greater local effort by the franchisee relative to a hired manager. We assume that G is increasing in the Company's cost of monitoring its own employees, m_{ik}. Finally, $E(\phi_{kt}, s_i, d_{kt})$, captures the free-riding costs, namely the losses associated with local agents deviating from contract requirements to the detriment of the Company's intangible assets. We expect free-riding costs to be decreasing in the level of regulatory stability ϕ_{kt}, both because local operator behavior may be easier to observe and interpret in more stable environments, and because of the decreased likelihood that enforcing the terms of the franchise contract, including franchisee termination, would be difficult or costly. Free-riding costs are expected to increase with the size of the hotel, s_i, as larger operations are likely to generate greater externalities (c.f. Lafontaine and Shaw (2005)). Finally, we expect E to increase with local market size or demand, d_{kt}, since reputation damage in more prominent markets should have larger financial consequences for the Company.

The implications of the model presented above for the relationship between organizational form and regulatory stability are straightforward. First, since both B and E are decreasing in ϕ, the model predicts that the Company should opt more often for management contracts - that is low equity investment but a high degree of control - in markets where regulatory policy is less stable. There is strong anecdotal evidence to support this prediction. For example, Marriott recently announced that it plans on increasing the number of its Middle Eastern properties from 26 to 65 by

able to "tell" someone to make a change in the physical property rather than having to "sell" an outside party on the change.

[14]Theory does not offer strong predictions as to how the benefits to flexibility would be affected by factors like the size of the property, the size or development of the local market, or cultural distance.

partnering with prominent local investors who will build and own hotels that the company will run under management contracts.[15] Given that most measures indicate that the regulatory environment is rather unstable in many of the region's countries, Marriott's decision to rely on management contracts to grow its presence in these markets is consistent with our model's prediction. Similarly, Accor's 2005 Annual Report indicates that growth in emerging markets, where regulatory stability is likely to be low, will mostly take place via management contracts and other joint ventures with local businesses.[16]

The model also implies that increased regulatory stability should be associated with a greater tendency for the firm to take an equity position in its hotels. However, it should also lead the Company to opt for more high, rather than low, powered incentive contracts - i.e. franchising - because of the Company's increased capacity to discipline free-riding in such contexts. The combination of these effects means that the model is ambiguous as to the ideal organizational form in countries with high regulatory stability. Whether company ownership or franchising dominates will depend on other characteristics of the local market and property involved. If monitoring costs are generally low and there are significant returns to ownership (higher R), then company ownership will be preferred. On the other hand, if monitoring tends to be costly (high G) and R is small, we expect to see more franchising.

Finally, the model offers predictions for how other hotel and market characteristics will affect organizational form decisions. First, we expect increased use of organizational forms in which the Company maintains operational control, namely management contracts or company ownership, in larger markets as market size is positively correlated with expected reputational costs. Second, because the size of a property increases both B and E, we expect management contracts to tend to be the

[15] Webwire, "Marriott to Manage Nine Properties in Saudi Arabia for Fawaz Abdul Aziz Al-Hokair & Associates Hotels Company," May 9, 2008.

[16] Accor, *2005 Annual Report*, p. 70.

organizational mode of choice for larger hotels.

2.3 Data and Methodology

We test the predictions above using proprietary data from a large, multi-brand multinational hotel firm. As mentioned previously, a confidentiality agreement prohibits us from disclosing the name of the company and any specific characteristic that might identify it. The data, which are at the hotel-year level, describe the organizational form, physical characteristics (i.e. size and location), brand affiliation, and some operational details of all the Company's international hotels between 1999 and 2003, for a total of 5,432 observations.[17]

2.3.1 Variable Definitions

We obtained the organizational form data, and thus the information needed to construct our dependent variables, directly from the company.

We proxy for our main independent variable of interest, namely the level of regulatory stability (ϕ_k) in a country, using two different measures. The first is the Checks index from the World Bank's Database of Political Institutions (DPI). It is based on the weighted number of veto players in a political system, where the weights are allocated based on analysis of electoral competitiveness, electoral rules, economic policy orientation and party affiliation.[18] Higher levels of stability are associated with

[17]The data exclude the Company's domestic hotels, where in any case we cannot use FDI or DPI as a predictor of organizational form decisions since these factors are expected to affect organizational form decisions in the context of international expansion, not domestic choices. Also, for half of the properties in a particular country, the Company changed their organizational form in the same year. Looking through news reports about the Company's development, these changes coincide with a period when the Company was aggressively expanding in this country in part by purchasing existing properties. Since the Company did not choose the original organizational form for the purchased hotels, we do not want to treat changes to a new form for these properties as equivalent to others in the data. We therefore exclude all the observations for that country up to the year of acquisition. After that point, we assume the organizational forms are chosen by the Company, and thus are comparable to the others in the data and should be included. Our results are robust to excluding all data from this country.

[18]Details on the construction of the index can be found in Beck et al. (2001) and Keefer and

institutional regimes where regulatory or policy changes are subject to multiple vetoes from multiple branches of government, and where the specific individuals with veto power come from different political parties. In other words, higher scores are associated with increased regulatory stability.

Second, since capital investments tend to flow to economies whose regulatory regime is more stable, we use the log of annual real foreign direct investment (FDI) inflows, in constant billions of dollars, obtained from UNCTAD, as a second proxy for the overall attractiveness of a given market, including the effect of its regulatory environment.[19] Our preferred way of using FDI inflows is as a 3-year moving average, which smooths away some of the data's lumpiness. However, when we include country fixed effects, we use the yearly data to leverage the year-to-year variation in our estimations.

Consistent with the empirical contracting and trade literatures (c.f. Brickley and Dark (1987), Rose (2004), Lafontaine and Slade (2007)), we measure monitoring costs, m_{ik}, by the physical as well as cultural distance from the principal's home. Specifically, we use the log of the physical distance (in kilometers) between the city where the Company is headquartered and the center of the city in which the hotel is located as our measure of distance.[20] For cultural distance, we identified two languages spoken in the firm's major markets. We set a dummy variable equal to 1 if one of these was

Stasavage (2003). One country in one year had a very high value for the Checks index (i.e. 16). We set this value to the next highest observed value (i.e. 8) to reduce the possibility that this outlier drives results. Our estimates are robust to leaving them unchanged or removing them entirely. Our results are also robust to winsorizing all observations with Checks scores higher than 5 to 5, the highest value that is relatively frequent in the data.

[19]Before taking the log of FDI we had to deal with the fact that a number of countries experienced net decreases in foreign investment in some years (in other words, more FDI was pulled out than put in). Rather than adding a constant to make all net FDI figures positive, which would have the effect of deemphasizing the relative importance of additional FDI in medium- and high-FDI countries, we took the log of the absolute value of the FDI inflows and multiplied it by -1 if the original figure was less than 0. To ensure that our transformation was monotonic, however, we first set the log equal to 0 if the absolute value of FDI inflows is less than $1 billion. The number of observations set to 0 is small. For the overall sample, we have 82 such cases out of 4,628, while we have 29 such observations out of a sample of 857 in the entry sample. Our results are robust also to other transformations of the variable.

[20]Distances are calculated using the "great circle" method.

the dominant language of the country where the hotel is located.[21] Language data are from from the Macalester College Industry Trade Data collection.[22] Moreover, we anticipate that in markets where the firm has a large presence, monitoring will be less costly as the fixed cost of traveling to the local market can be spread across a larger number of hotels. Consequently, we include the total number of hotels affiliated with the Company, across all brands, in the same city as hotel i as an additional measure of monitoring costs.

We measure hotel size (s_i) using the log of the number of rooms in the hotel.

To proxy for market size (d_k), we use the log of real per capita GDP and the log of country population, both from the World Bank's World Development Indicators. Also, motivated in part by the discussion in international lodging firms' investor reports about economic as well as political stability affecting investment decisions, we include the standard deviation of each country's economic growth rate for a rolling three-year window in all our regressions. In other words, the value of this variable for a given country in a given year is the standard deviation of that country's economic growth over the current and two preceding years, where data on economic growth are from Euromonitor. Controlling for economic volatility ensures that our coefficient on regulatory stability captures the impact of this variable separately from any effect of economic volatility. It also allows us to partially test the prediction that when returns are likely to be more volatile, local agent effort becomes more important so that the firm transfers greater responsibility and offers higher powered incentives to local agents.[23] This would imply greater reliance on franchising in nations characterized by high economic volatility.

We include brand-year dummy variables to control for possibly time-varying dif-

[21] We estimated models with separate dummy variables for the two languages, and obtained very similar results. Since the coefficients were very similar, we present results for the more parsimonious version.

[22] The data can be accessed at:
http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradedata.html.

[23] See, e.g. Lafontaine and Bhattacharyya (1995) and Prendergast (2002).

Table 2.2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
DPI Checks	5,251	3.61	1.27	1.00	8.00
FDI	5,149	42,936	66,514	-4,192	313,997
Log (transform of smoothed FDI $B)	5,029	2.93	1.57	-0.72	5.55
Log (transform of FDI $B)	5,149	2.83	1.55	-1.16	5.75
Real GDP per capita (income)	5,252	15,681	10,463	103	46,659
Log (income)	5,252	26.65	1.58	19.11	29.96
StDev (growth)	5,353	1.40	1.43	0.10	12.34
Country Population ('000s)	5,252	77,900	143,000	388	1,290,000
Log (population)	5,252	17.48	1.23	12.87	20.98
Number of rooms	5,432	132	89	2	702
Log (rooms)	5,432	4.68	0.66	0.71	6.55
Language	5,432	0.21	0.40	0	1
Distance (km) to city	5,336	3,990	4,844	225	19,072
Log (distance (km) to city)	5,336	7.44	1.35	5.42	9.86
Number of Company hotels in city	5,070	5.85	7.38	1.00	42.00

ferences across the brands of the Company. These dummy variables control for brand-specific factors that may affect organizational form decisions, including, for example, differences in the amount of local managerial effort that may be required across the brands.[24]

Summary statistics for all the variables above are shown in Table 2.2. It was not possible to obtain market level data for all the hotel/years in our Company data. In the end, we have 4,853 observations with all relevant variables and the DPI Checks index, whereas we have 4,628 observations when we rely on the 3-year moving average FDI measure of regulatory stability, and 4,741 observations when we use yearly FDI data and country fixed effects.

Table 2.3 shows the number of hotel/years by organizational form for countries with high, medium, and low levels of regulatory stability, as captured by the DPI index. Since observations are at the hotel/year level, multiple observations of the

[24]For example, specific groups of amenities are offered by hotels operating under the different brands, and these amenities likely affect the importance of local effort and the cost of monitoring its provision.

Table 2.3: Organizational Form and Regulatory Stability

	DPI Checks Group			
Organizational Form:	1-3	4	5+	Total
Company Owned	982	1,589	477	3,048
	51.7%	*62.5%*	*58.7%*	*58.0%*
Management Contract	838	619	243	1,700
	44.2%	*24.4%*	*29.9%*	*32.4%*
Franchised	78	333	92	503
	4.1%	*13.1%*	*11.3%*	*9.6%*
Total	1,898	2,541	812	5,251

Notes: Number of hotel-year observations with percentage of column total in *italics*.

same hotel appear in the table. The first column shows data for countries that receive scores of 1 to 3 in the DPI Checks index. This category includes countries like Côte d'Ivoire, Morocco, and Ghana. The second columns shows the organizational forms for hotels in countries with a Checks score of 4, which includes Argentina, Peru, and South Korea. The final column displays the distribution of forms in countries where power is considered most evenly distributed. This group includes the Netherlands, Australia, and New Zealand (in most years).

The data in Table 2.3 first show that the majority of the Company's hotels are in countries with more stable regulatory regimes. Conditional on operating in the least stable regulatory environments, 50 percent of hotels are company-owned, compared to about 60 percent in countries with moderate to very stable regulatory environments. Finally, we find more franchising in moderate and stable environments (11 to 13 percent) than in the least stable environments (just 4 percent).

These data patterns are consistent with the predictions of our model.[25] However, they may be due to other factors correlated with regulatory stability that are not controlled for in simple descriptive statistics. In what follows, we examine whether the same relationships arise in more systematic regression analyses.

[25]The results are similar if we use one observation per hotel or our smoothed measure of FDI.

2.3.2 Empirical Specification

Organizational form decisions in the lodging industry have been analyzed using ordered response models (c.f. Contractor and Kundu (1998b), Chen and Dimou (2005)). These models assume the existence of a single continuous unobserved index along which the organizational forms can be ranked. The estimated cutoff values for the index then dictate the choice of organizational form along the continuum. We believe that this approach is problematic in the present context because our model suggests that the differences in organizational forms cannot be reduced to a single dimension. This should be clear from Table 2.1 where the organizational forms differ along two dimensions. Similarly, some of the key factors in our model - like hotel size or regulatory stability - affect both the decision to own and the decision to franchise in different ways. As a result, we view non-ordered discrete choice models as more appropriate.

Our initial choice of specification was the multinomial logit (MNL) model. This model has many attractive features, not least of which is its analytical tractability. However, this tractability comes at a high cost, namely the requirement that the probability of choosing one possibility relative to another must be independent of irrelevant alternatives (IIA). In other words, shocks to the true utility associated with the different choices must be independent and identically distributed. In a context such as ours, where the set of alternatives is small, and no alternative is highly similar to any other, the IIA assumption is perhaps not so problematic. However, tests of the IIA assumption on our data using a modified Hausman test (c.f. Hensher et al. (2005), Cameron and Trivedi (2005)) were rejected. For that reason, we turned to the less restrictive generalized extreme value (GEV) models.

The most common GEV model is the nested logit, in which choices are grouped into "nests" according to the likelihood of correlations in the error terms. Frequently, these groupings are established on theoretical grounds, but as Hensher et al. (2005)

explain, this is not necessary. One way to evaluate the appropriateness of the nested logit compared to MNL is to consider the inclusive value parameters. These parameters are the estimated ratio of the scale parameter at one level of a model and the scale parameter at the level below. Scale parameters are functions of the correlation between the error terms of the elements within a choice set.[26] In the MNL model, the inclusive value parameters are set equal to 1 at all levels because of the assumption that the variances of all alternatives are independent and identical. Nested logit models allow these variances to vary across alternatives, potentially leading to different scale parameters at different levels of the model. The inclusive value parameter values must be between 0 and 1. If the estimated value is equal to 0, the model is "degenerate" because the estimated coefficient implies that there is no nesting structure. When the ratio is statistically indistinguishable from 1, the model is equivalent to the MNL. If the ratio is greater than 1, the model violates the global utility maximization assumption.[27]

Since we have only three organizational forms, a nested structure implies that there will be two branches, one of which will have two alternatives as stems. Thus only one inclusive value parameter can be estimated since we must normalize the inclusive value of the branch with only one alternative to 1.

We estimated all three possible nesting structures, namely the one that groups the two non-equity modes (management and franchise), the one that groups the two modes that entail control over local operations by the Company (company ownership and management contract), and finally the one that groups company ownership and franchising. However, because our data are about characteristics of the property rather than attributes of the organizational form, we can only estimate effects via interacting organizational form dummy variables with the characteristics. Unfortu-

[26] See Hensher et al. (2005) or Cameron and Trivedi (2005) for details.

[27] In other words, this would mean that an increase in the utility associated with a specific alternative would lead to a *decreased* probability of choosing the branch it is on. For more, see Hensher et al. (2005).

nately, our model contains too many variables to proceed in this way. We were able to estimate nested logit models for all nesting structures when we restricted the set of explanatory variables to the main variables of interest, excluding our brand-year dummy variables.

We found that the only model with an inclusive value coefficient not statistically significantly greater than 1 associates the two non-equity forms, namely management contracts and franchising. However, estimation of this model produced an inclusive value parameter that was statistically indistinguishable from 1. As noted above, this implies that the best nested model is equivalent to an MNL model. Further bearing this out is the fact that our nested logit estimates were very similar to the MNL estimates. As a result, we follow Train (2003) in thinking of the MNL regressions as a worthy approximation to the true choice process, and present results from this model.

Table 2.4: Organizational Form Changes From One Period to the Next

		Current: C	M	F	Total
Previous:	C	2,330	26	1	2,357
		96.9%	*2.0%*	*0.3%*	*58.3%*
	M	71	1,245	19	1,335
		3.0%	*97.6%*	*5.3%*	*33.0%*
	F	3	5	340	348
		0.1%	*0.4%*	*94.4%*	*8.6%*
	Total	2,404	1,276	360	4,040

Notes: Number of hotel-year observations with percentage of column total in *italics*.

The MNL model connects very easily to the theoretical model outlined above. If we add error terms to the value functions associated with each of the different organizational forms, where the error terms are independent and identically drawn from the type 1 extreme value distribution, and the value functions are assumed to be linear functions of the explanatory variables X, then the probability of observing

a given organizational form f is:

$$\begin{aligned} Pr[f] &= \frac{V_f}{\sum_j e^{V_j}} \\ &= \frac{e^{X\beta^{(f)}}}{\sum_j e^{X\beta^{(j)}}}, \end{aligned}$$

for $j = C, M, F$. The error terms capture unobserved factors that might cause the Company to prefer one form over the others. The resulting empirical model is not yet identified, however, because there are multiple sets of $\beta^{(f)}$ that lead to the same probabilities. Identification is achieved by arbitrarily setting $\beta^{(f)}$ to 0 for one f. We set this default case to be company ownership. This means that we are modeling the effect of variables on the relative probability that a given hotel i in country k at time t is operated under organizational form f, where f is either franchising or a management contract, relative to company ownership. Separating X into the three functions identified in our modeling section, this translates to:

$$\begin{aligned} ln\left(\frac{P(\text{form} = f)}{P(\text{form} = \text{C})}\right)_{ikt} &= -B_f(s_{it}, \phi_{kt}) + G_f(m_{ikt}) - E_f(s_{it}, d_{kt}, \phi_k) + \mu_{ikt} \\ &= \delta_\tau \phi_{kt} + \beta_{1,\tau} s_{it} + \beta_{2,\tau} m_{ikt} + \beta_{3,\tau} d_{kt} + \mu_{ikt} \end{aligned}$$

where μ_{ikt} represents an idiosyncratic shock, and C indicates company-ownership.[28]

In the next section, we first present MNL results for the full sample of yearly observations. This approach fundamentally assumes that the Company chooses or reconsiders the organizational form under which each hotel is operated at any given time during the period of our data. Only about 5% of the hotels in our sample, however, experience a change in organizational form at any given time during the period of our data. Table 2.4 indicates the frequency of such changes per hotel/year in our data. It clearly shows that for most hotel/years, there are no changes in

[28] R does not appear here as it is not part of the value functions of the non-equity forms.

Table 2.5: Full Sample Results

	DPI		FDI		FDI FE	
	M:C	F:C	M:C	F:C	M:C	F:C
Reg. stability	-0.55***	0.05	-0.58**	-0.28	-0.35***	0.00
	[0.20]	[0.22]	[0.26]	[0.19]	[0.09]	[0.09]
Local presence	0.00	-0.06***	-0.01	-0.05***	0.02	-0.07***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Language	-1.14*	-2.26**	-1.26**	-2.40***		
	[0.60]	[0.98]	[0.60]	[0.86]		
Log (distance)	1.04***	0.02	0.94***	0.05	0.97	1.10**
	[0.18]	[0.22]	[0.25]	[0.25]	[0.81]	[0.52]
Log (rooms)	0.17	-0.49	0.15	-0.47	-0.21	-0.84**
	[0.16]	[0.35]	[0.18]	[0.36]	[0.18]	[0.38]
Log (income)	-0.32	-0.31	-0.13	-0.03	-0.12	-2.79
	[0.22]	[0.32]	[0.26]	[0.29]	[6.80]	[10.06]
Log (population)	-0.08	0.23	0.2	0.23	-17.22	-8.71
	[0.30]	[0.33]	[0.22]	[0.27]	[12.08]	[17.16]
StDev (growth)	0.29*	0.16	0.17	0.09	0.09	0.00
	[0.15]	[0.18]	[0.16]	[0.18]	[0.37]	[0.35]
Constant	30.46***	7.34	20.74***	0.32	338.14	214.71
	[4.05]	.	[5.80]	.	.	.
Brand-year FE	Yes		Yes		Yes	
Country FE	No		No		Yes	
Observations	4,853		4,628		4,741	
Correctly Predicted	3,938		3,806		4,103	
% Correct	81%		82%		87%	

Notes: Robust standard errors, clustered at the country-level, in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. We were unable to identify the constant term in the second, fourth, fifth, and sixth columns because of collinearity with the brand-year dummy variables.

organizational form (per the elements along the diagonal). This low frequency of changes in organizational form suggests either that the firm has not had much need to change the organizational form under which its hotels operate, or that it cannot easily change these decisions. The latter seems consistent with the long-term nature of both franchised and management contracts. However, firms do buy back franchised properties to operate them as their own, and at times choose to franchise hotels that were company-owned, leading us to expect that the lack of changes in the year-to-year data mostly reflect the fact that the Company has not had much need to change organizational form. In that case, the use of yearly data is justified. But if the decisions are sticky, then yearly data may be at too high a frequency to reflect the number of decisions actually made. For this reason, in our regressions below, we cluster observations at the country level. In addition, we present a separate set of results, obtained using only one observation per hotel. Specifically, we use an entry subsample, which consists of only those hotels whose organizational form is observed when they first become part of the Company's portfolio, and we include each hotel only in that year. Comparing the results of the analysis on this entry subsample with those of the full sample serves as our most important robustness check (see below).

2.4 Regression results

2.4.1 Baseline Results

Table 2.5 shows the results of three MNL regressions of organizational form using our entire sample. In the table, each model is represented by a pair of columns. The first column in the pair shows the effect of each variable on the probability that a hotel is organized under a management contract rather than company ownership. The second column indicates the effect on the relative probability of franchising versus company ownership.

In the first set of two columns, we use the DPI Checks variable as our measure of regulatory stability. In the second and third sets of columns, we rely on the log of the 3-year moving average of FDI and the log of yearly FDI inflows and country fixed effects, respectively. We include results from this last specification in particular to establish that our results concerning regulatory stability are not driven by unchanging country characteristics. Moreover, these country fixed effects also should account, among other things, for the possibility that some countries inhibit - or prohibit outright - foreign ownership.[29] We do not include country dummy variables in regressions that use the Checks index or the other measure of FDI because these do not vary sufficiently over time for us to identify their coefficients separately from those of country fixed effects.

We cluster errors at the country level in all these regressions to account for the fact that the Company's organizational form choices may be correlated not only over time within a hotel but also across hotels in a given country.[30] χ^2 tests that the coefficients on the brand-year dummy variables are all equal to zero are rejected at the 1% level for all but our country fixed effect regression.

We measure the goodness of fit using the share of correctly predicted choices, where the predicted outcome for each hotel is determined by selecting the form with the highest predicted probability. The models all correctly predict more than 82 percent of the "yearly" choices, much above the 58-59 percent that we would predict if we used a naive model and predicted company ownership - the most frequent outcome in the data - for all observations.

Given that the models are non-linear, to facilitate the interpretation of the results,

[29] We unfortunately do not have data to identify clearly the countries where this may be an issue during our data period. Consequently, we not only estimate regressions with country fixed effects, but also experimented with subsamples where we removed data from countries where we suspected such restrictions might exist. We found that our results were robust across these.

[30] Clustering at a more aggregate - country rather than hotel - level allows for all observations from a given country to be treated as though they are not fully independent from one another, thereby "reducing" the sample size the most. This makes it more difficult to find statistically significant results in the regressions, and hence is a conservative approach to the issue at hand.

Table 2.6: Marginal Effects for Whole Sample

	DPI		
	Company Owned	Management Contract	Franchised
Reg. stability	0.041	-0.057	0.016
Local presence	0.018	0.006	-0.025
Language	0.148	-0.070	-0.078
Log (distance)	-0.116	0.139	-0.023
Log (rooms)	0.004	0.016	-0.020
Log (income)	0.056	-0.036	-0.020
Log (population)	-0.006	-0.015	0.021
StDev (growth)	-0.041	0.034	0.007
	FDI		
	Company Owned	Management Contract	Franchised
Reg. stability	0.084	-0.074	-0.010
Local presence	0.020	0.001	-0.021
Language	0.160	-0.080	-0.080
Log (distance)	-0.103	0.123	-0.020
Log (rooms)	0.004	0.015	-0.019
Log (income)	0.017	-0.019	0.002
Log (population)	-0.031	0.017	0.013
StDev (growth)	-0.023	0.020	0.003
	FDI-FE		
	Company Owned	Management Contract	Franchised
Reg. stability	0.023	-0.029	0.006
Local presence	0.012	0.012	-0.024
Log (distance)	-0.132	0.060	0.073
Log (rooms)	0.025	-0.002	-0.023
Log (income)	0.071	0.006	-0.078
Log (population)	0.217	-0.233	0.016
StDev (growth)	-0.006	0.007	-0.001

Note: Average impact on probabilities of different organizational forms of a one standard deviation increase in the independent variable holding all others constant. For the dichotomous language dummy, the value is calculated by taking the average of the difference in probabilities when the value is set to 1 and when it is set to 0.

we present in Table 2.6 the average effect of a one standard deviation increase in the independent variables. As suggested in Cameron and Trivedi (2005, p. 122-3) and Greene (2003, p. 668), we approximate the marginal effects of a change in one of the independent variables by using the average effect of such a change, rather than calculating the effects at mean values. For the language dummy variable, the effect is calculated by taking the average of the difference in probabilities when the variable is set to 1 compared to when it is set to 0.

Overall, our results are consistent across specifications and strongly support our model's predictions about the impact of regulatory stability on the choice of organizational form. In all three specifications, an increase in regulatory stability decreases the likelihood of choosing a management contract relative to company ownership. Moreover, the estimates of a one-standard deviation change suggest that the impact of regulatory stability on organizational form choice is economically significant. Depending on the specification, we find that a one standard deviation increase in regulatory stability leads to a 2.9 to 7.4 percentage point decrease in the likelihood that a property is operated under a management contract. Across all three models, we find that this decrease is almost wholly accounted for by increased use of company ownership. In other words, regulatory stability almost exclusively affects the asset ownership decision.

The result above differs from others in the literature on lodging company contracting. Contractor and Kundu (1998b) use hotels data where it is possible to distinguish four types of contractual relationship, which they order from most to least company involvement as follows: first, company ownership; then, partial ownership; next, management contracts; and lastly, franchising. Chen and Dimou (2005) do not have a partial ownership category, but order the remaining organizational forms in the same way. Both papers find a statistically significant negative relationship between company involvement and country risk, implying that franchising is the dominant

organizational form in the riskiest countries. Allowing differential effects along the control and ownership decisions, however, we find instead that the Company eschews ownership in the riskiest countries but maintains control.

As for the other hotel and market characteristics in our regressions, we find results that are generally in line with our model's predictions. In particular, based on monitoring cost arguments, we expect to find more company ownership and correspondingly less franchising in cities with higher densities of hotels affiliated with the Company, as we do. Similarly, we find that reduced cultural distance, as captured by our common language dummy variable, increases the chances that a hotel is company owned by 15 to 16 percentage points, while reducing the likelihood of both management contracts and franchising approximately equally. In other words, the Company owns more readily in markets that are culturally closer to its main markets. Increases in the physical distance between the Company's headquarters and the city in which the property is located are associated with a reduced reliance on company ownership, also as expected. Interestingly, in this case the reduced reliance on company ownership is made up for by a corresponding increase in the use of management contracts, and no change in the tendency to franchise (in two out of three models). This suggests that free-riding concerns also are relatively high in far away markets. Finally, larger hotels are less likely to be franchised, as expected based on free-riding concerns.

As for the country-level variables, once we control for regulatory stability, GDP per capita and country population never have statistically significant effects on organizational form decisions.[31] Finally, economic volatility, as captured by the standard deviation of GDP growth in the country, tends to increase the reliance on management contracts and reduce company ownership. This result does not support the Prendergast (2002) prediction of increased delegation in more volatile environments.

[31]The magnitude of the effects, per Table 6, can be sizable, but consistent with the high estimated variances, the signs of the effects in Table 8, where we focus on our entry subsample, are not consistent with those in Table 6.

Moreover, in models 2 and 3, the magnitude of this effect is much smaller than that found for regulatory stability. More important for our purposes, the inclusion of this variable does not eliminate the effect of regulatory stability. This confirms that regulatory stability plays a role in organizational form decisions that is separate from that of economic volatility.

2.4.2 Robustness

We show results for the entry-year subsample in Table 2.7. As noted above, these results will be consistent even if our assumption that the Company revises organizational form decisions every year is incorrect. However, if this assumption holds, they will be less efficient due to the smaller sample size.

In these regressions, we include observations of hotels that opened between 1997 and 2003 on the presumption that the organizational form we observe in 1999 is still the initial one, even if we do not have data on organizational form at the exact time of entry. We make this assumption in order to increase sample size, which otherwise would include very few franchised observations. Only two models are estimated, because there are not enough observations to identify effects when country dummy variables are included. As in the full sample regressions, we include brand-year dummy variables and cluster the standard errors at the country level. χ^2 tests reject the null that the coefficients on the brand-year dummies are jointly indistinguishable from 0 at the 1% level. Table 2.8 shows the average effects of a one standard deviation increase in the different independent variables.

As with the full sample, we find that an increase in regulatory stability has a negative and significant impact on the likelihood that a hotel is administered under a management contract rather than owned by the Company. Also consistent with our results above is the fact that we find no statistically significant impact of regulatory stability on the relative likelihood that a hotel is franchised rather than company

Table 2.7: Entry Sample Results

	DPI		FDI	
	M:C	F:C	M:C	F:C
Reg. stability	-0.59***	0.17	-0.55*	-0.2
	[0.22]	[0.24]	[0.32]	[0.34]
Local presence	0.01	-0.11***	0.01	-0.10**
	[0.02]	[0.04]	[0.02]	[0.04]
Language	-0.28	-37.42***	-0.35	-37.50***
	[0.53]	[0.73]	[0.58]	[0.63]
Log (distance)	1.28***	0.07	1.22***	0.31
	[0.20]	[0.30]	[0.26]	[0.24]
Log (rooms)	0.14	0	0.2	0.04
	[0.19]	[0.28]	[0.21]	[0.33]
Log (income)	-0.23	0.36	-0.12	0.54
	[0.19]	[0.25]	[0.27]	[0.42]
Log (population)	0.1	-0.21	0.28	-0.29
	[0.21]	[0.27]	[0.22]	[0.29]
StDev (growth)	0.15	0.08	0.12	-0.1
	[0.17]	[0.19]	[0.16]	[0.21]
Constant	-20.82	-30.25	-26.55	-33.3
	[39.17]	.	.	.
Brand-year FE	Yes		Yes	
Observations	874		857	
Correctly Predicted	721		713	
% Correct	82%		83%	

Note: Robust standard errors in brackets - clustered at the country-level. * significant at 10%; ** significant at 5%; *** significant at 1%. We were unable to identify the constant term in the second, third, and fourth columns because of collinearity with the brand-year dummy variables.

owned. The estimated average effects of a one standard deviation increase in regulatory stability are of similar magnitude as in our overall sample. We find that a one standard deviation increase in the regulatory stability variables is associated with a 5.9 to 6.8 percentage point decrease in the likelihood that a property is under a management contract. For FDI, this effect again is almost entirely offset by an increased utilization of company ownership. For the DPI Checks variable, the impact is offset by increases in both company ownership and franchising.

Our other variables also have effects similar to those in our full sample regressions.

Table 2.8: Effects of One Standard Deviation Change Based on Entry Results

	DPI		
	Company Owned	Management Contract	Franchised
Reg. stability	0.032	-0.059	0.027
Local presence	0.025	0.021	-0.046
Language	0.114	0.047	-0.161
Log (distance)	-0.111	0.142	-0.031
Log (rooms)	-0.006	-0.006	-0.002
Log (income)	-0.007	-0.042	0.049
Log (population)	0.003	0.014	-0.018
StDev (growth)	-0.019	0.015	0.004
	FDI		
	Company Owned	Management Contract	Franchised
Reg. stability	0.069	-0.068	-0.001
Local presence	0.020	0.021	-0.041
Language	0.109	0.044	-0.153
Log (distance)	-0.110	0.127	-0.016
Log (rooms)	-0.009	0.011	-0.001
Log (income)	-0.029	-0.039	0.068
Log (population)	-0.009	0.037	-0.028
StDev (growth)	-0.005	0.017	-0.012

Note: Average impact on probabilities of different organizational forms of a one standard deviation increase in the regulatory stability proxy holding all other variables constant.

In particular, we find again that greater physical and cultural distance increase the likelihood of both non-equity organizational forms. One variable that has different effects in the subsample analyses is the log of GDP per capita, which we find to have a small negative effect on the probability of company ownership and a larger positive effect on the probability of franchising. As before, however, these effects are statistically insignificant at conventional levels.

Though not shown, we have also verified that our results remain similar if we rely on alternative measures of institutional stability, namely the Political Constraint Index, which is similar to the Checks variable insofar as it is explicitly intended to capture the stability of the policy environment, or the mean of the World Bank's

governance indicators.[32] Overall, the consistency of our results between the subsample and the full sample, as well as across different measures of regulatory stability, offers strong support for the predictions of our model.

2.5 Conclusion

Using proprietary data from a large multi-national multi-brand lodging firm, this paper has examined the effect of differences in regulatory stability across countries on the way in which the Company chooses to organize its operations locally. We show that the Company is less likely to choose to be sole owner and residual claimant when a hotel is in a country where the "rules of the game" can be changed more easily. This is consistent with the idea that lower levels of regulatory stability increase the risks attached to company ownership. The firm still chooses to do business in these markets, however, by partnering with local investors who, often because of who they are, can mitigate the risks associated with unexpected policy or regulatory changes. The data indicate that it then prefers to maintain operational control through the use of management contracts rather than relying on franchising. We argue that this occurs because free riding is harder to detect or punish in environments characterized by unstable regulatory regimes. This, in turn, makes franchising less appealing in such markets.

Overall, our results show that the Company's organizational form decisions vary significantly depending on the characteristics of the market in which a given hotel is located, and that regulatory stability is one of the important factors affecting these decisions. Our findings thus demonstrate that regulatory considerations can affect the behavior of firms in the service sector as well as those in manufacturing and other heavy industries. Our hope is that future work will consider how this effect might

[32]For these analyses, missing values for the governance indicators were imputed using data from other years to maintain the number of observations in the sample. Details are available upon request.

vary across service industries, as well as how other organizational decisions - beside those available in this industry - might be relied upon by firms in these other sectors.

CHAPTER III

Uncertain Regulatory Timing and Market Dynamics

> *[I]n 2002 and 2003 Granger Morgan of Carnegie Mellon ... asked large audiences which included many CEOs and other senior officials in the power industry, How many of you believe that there will not be Federal controls on CO2 emissions from U.S. power plants within the next 20 years? In both cases less than 2% of the people in the room raised their hands.* (Reinelt and Keith (2007, p. 102))

3.1 Introduction

In addition to obvious influences like the level of demand, firms' investment decisions depend on their regulatory context, the future of which often is uncertain. Such uncertainty can arise in two ways. First, firms may be unsure about the specific nature of future regulations. For example, policymakers and stake-holders currently are debating the relative merits of different ways of reducing greenhouse gas emissions (see, e.g. Crook (2009)). Second, even when the nature of future regulations is foreseeable, decision-makers still may face regulatory uncertainty if the timing of the change is unclear. Either form of regulatory uncertainty complicates durable invest-

ment strategies.[1] As a result, when the regulatory future is uncertain, firms' durable investment strategies should look different than they would in the absence of this uncertainty.

In monopolistic settings, the impact of uncertainty about regulatory changes can be modeled using the approaches developed in the "real options" literature (e.g. Dixit and Pindyck (1994)) and usually applied to demand uncertainty. This framework predicts that firms in uncertain markets delay durable investments to obtain more information. However, if the market is oligopolistic, the question of how uncertainty affects investment becomes more difficult to answer. This is because an oligopolist's optimal strategy depends on the actions and states of its competitors, and the durability of investments can create incentives for oligopolists to engage in preemption races (see, e.g., Spence (1977)). Thus, there are two opposing forces on oligopolists facing exogenous uncertainty: 1) wait for more information about the future competitive environment, and 2) act quickly in an effort to improve their position within the market.

In this article, I examine the tension between these forces by extending the Besanko and Doraszelski (2004) infinite horizon, discrete time model of dynamic capacity accumulation to allow for a one-time regulatory change that alters the parameters affecting product market competition. In my model, uncertainty about the regulatory future is restricted to the timing of a new Pigouvian (i.e. pollution) tax designed to cause firms to internalize an externality in their production process. In each period, firms compete on price in the product market and make decisions about how much to invest in expanding their productive capacity, knowing that in the long-run the tax will reduce the industry's profitability to the extent that it can only support one firm. In many ways, this set-up resembles what has occurred to the market for methyl

[1]For example, a project that may be desirable under one regulatory regime could be unprofitable under others. Alternatively, building a new plant might be advisable if a stringent regulatory regime were adopted in the distant future, but not if it went into effect in the next period.

tert-butyl ether (MTBE), a gasoline additive used to increase fuel's octane level. After becoming the dominant oxygenate, MTBE was found to significantly contaminate groundwater, and it's production has fallen sharply as a result of increased regulatory stringency.[2]

I assess the impact of uncertainty on oligopolistic competition by numerically solving for firms' Markov Perfect Nash equilibrium investment policies when the arrival time of the regulatory change is known with certainty and when it is uncertain. Contrasting firms' policy functions reveals that the standard real options understanding of the impact of uncertainty on investment does not always hold. Depending on market structure and the level of uncertainty about the arrival time of the Pigouvian tax, firms sometimes invest *more* when the timing of the change is uncertain than when it is known.

Two factors combine to produce these results. First, they occur because of the type of uncertainty considered here, which involves a drop in the value of capacity. Firms do not wish to have a large capacity overhang that will not be used once the regulatory regime changes. Knowing exactly when the transition will take place allows for more precise calibration of how much to cut investment if firms have large existing capacity stocks. Second, investment is affected by firms' strategic incentives, which vary depending on the market structure. Because having the largest capacity stock at the time of the regulatory change dramatically increases the likelihood of being the monopolist, the capacity race dynamic created by engaging in capacity-constrained price competition is amplified between firms with symmetric, small capacity stocks that know when the change will occur relative to analogous firms in markets where the change's timing in uncertain.[3] Similarly, the race dynamic is relatively more intense between firms with larger capacity-stocks in markets where the timing of the

[2]Background information on MTBE and its regulation can be found at http://www.epa.gov/mtbe and http://en.wikipedia.org/wiki/Methyl_tert-butyl_ether.

[3]See Besanko and Doraszelski (2004) for discussion.

change is uncertain. These firms continue to invest heavily even when both have large capacity stocks because of the asymmetric payoffs to being largest at the time of the change. Although the change may be anticipated to occur soon, the possibility that it will not and there will be time for market structure to change justifies these expenditures.

I subsequently analyze how firms' discounted streams of expected profits vary as a function of regulatory uncertainty and their capacity states. Intuitively, I find the variation over different capacity states in uncertainty's impact on investment behavior recurs. In addition, using tools from stochastic process theory, I show that the impact on firms' investment strategies and profits also produces substantial differences in total welfare. I find that, on average, total welfare is higher when the timing of the regulatory change is certain, and that greater uncertainty is linked to higher costs. These findings imply that welfare can be improved, on average, if policy-makers can reach agreement at an earlier time, even if that necessitates a regulatory change that is not ideal.

This article contributes to a number of literatures. First, it adds to the growing literature incorporating exogenous shocks or uncertainty into models of strategic interaction (see, e.g., Ghemawat and Nalebuff (1985), Whinston (1988), Grenadier (2002), Lambrecht and Perraudin (2003), Murto et al. (2004), Collard-Wexler (2006), Bushnell and Ishii (2007), Besanko et al. (2010)). Methodologically most related to this paper is Besanko et al. (2010), which examines how demand uncertainty affects (dis)investment dynamics. Using a different model of capacity dynamics, which allows for deterministic investment and disinvestment, they find that the presence of exogenous uncertainty can have an affect on the multiplicity of equilibria, and can lead to both more or less aggressive investment behavior. However, in two of the three discovered equilibria, size conveys a strategic advantage – as in this paper.

Second, the article contributes to the small but growing literature on how uncer-

tainty about regulatory conditions in particular impacts investment and other firm decisions (e.g. Henisz and Zelner (2001), Ishii and Yan (2004), Lee and Alm (2004), Reinelt and Keith (2007), Wilson et al. (2009)). Unlike the current paper, the majority of previous work on regulatory uncertainty has focused on industries where strategic dynamics do not apply. In general, the literature has supported the real options prediction that uncertainty about the regulatory future leads to lower investment. While consistent with their emphasis on the beneficial effects of a good policy environment, this paper indicates that uncertainty does not necessarily have a clear comparative static with respect to investment, especially when there are significant strategic incentives.

The remainder of the article proceeds as follows. Section 2 presents the model. In Section 3, I examine how uncertainty about the arrival of a regulatory change impacts firm strategies conditional on the structure of the market. In Section 4, I show how these differences affect social welfare. Section 5 concludes.

3.2 Model

I modify Besanko and Doraszelski (2004)'s extension of the Ericson and Pakes (1995) industry evolution framework to allow the state space to vary in ways besides firms' capacities. The approach is general enough to accommodate variation in any of the parameters affecting demand, the cost of investment, etc. However, I describe the model as used in this application, where the exogenous variation takes the form of a single change in the marginal cost of production. Also, while the model could straightforwardly be extended to the n-firm case, I describe the duopoly setting employed in this paper.

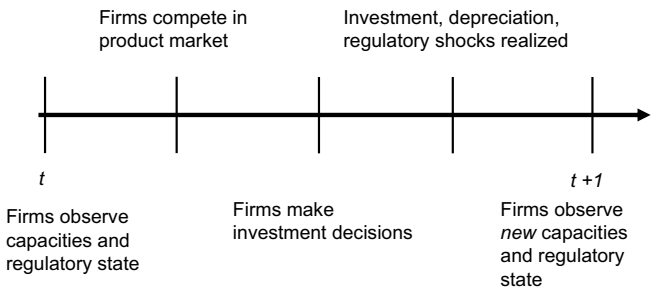

Figure 3.1: Timing of events in the game

Setting and Timing of Events

I consider two infinitely-lived, homogeneous good producers engaged in capacity-constrained price competition in a discrete-time, infinite horizon setting. In any given period, each firm i's possible production capacity $\overline{q^i}$ can take on one of $0 \leq M-1 < \infty$ values. For simplicity, I set the interval between the different productive capacities to be the same. The firms have symmetric cost structures which are determined by the regulatory state $s \in \{u, r\}$, where u indicates unregulated and r indicates regulated.

Figure 3.1 shows the timing of events in each period t of the model. First, both firms observe the state of the world, which is given by $(\overline{q^1}, \overline{q^2}, s)$, where $\overline{q^i}$ indicates the capacity of firm i in the market and s indicates the current regulatory regime. Second, the firms compete in the product market, with each firm i earning payoff $\pi^i(\overline{q^1}, \overline{q^2}, s)$. Third, the firms make their investment decisions, which (along with depreciation) will affect the likelihood of different capacity state transitions. Fourth, and finally, the state evolves to $(\overline{q^1}', \overline{q^2}', s')$.

Product Market Competition

I specify that firms engage in quantity-constrained price competition (i.e. Bertrand-Edgeworth competition).[4] Demand is linear and given by the inverse demand function:

$$P = a - bQ,$$

where P is the market price, and Q is aggregate production. Marginal costs c_s are common to all firms, and are regulatory state dependent. The two firms compete by simultaneously setting their prices (p_1, p_2) conditional on the capacity states, a situation first analyzed by Kreps and Scheinkman (1983) and generalized in Deneckere and Kovenock (1996) and Allen et al. (2000).

I follow Besanko and Doraszelski (2004) in their approach to equilibrium selection. This involves imposing the efficient rationing rule, which implies the following. If $p_1 > p_2$, then firm 2 supplies the entire market provided it has the production capacity to do so. If it does not, firm 1 serves the residual demand. Thus, the profit of firm 1 is $p_1 * \max\{0, Q(p_1) - \overline{q^2}\}$, and the profit of firm 2 is $p_2 * \min\{\overline{q^2}, Q(p_2)\}$. To specify firms' prices in different capacity states, I employ the generalized approach of Deneckere and Kovenock (1996).[5] The approach leads to the identification of three regions: A, B, and C.

In region A, neither firm has the capacity to produce at the level that their Cournot best-response function indicates, i.e. $\overline{q^1} \leq q(\overline{q}^2)$ & $\overline{q^2} \leq (\overline{q^1})$, where $q(\overline{q})$ is the Cournot best-response function to a competitor producing $\overline{q}$. In this region, the equilibrium is for both firms to charge the market clearing price; thus, $\pi^i = \overline{q^i} P(\overline{q^1} + \overline{q^2})$, for $i = 1, 2$.

[4] I have also solved the model assuming that the firms engage in capacity-constrained quantity competition. The key qualitative insight of this paper – i.e. that initial conditions matter in how firms respond to regulatory uncertainty, and that uncertainty can produce excessive investment – is robust to this reparameterization. Details are available upon request.

[5] For the specifics and intuition of the approach, readers should refer to that paper.

In region B, both firms have the capacity to serve the entire market, i.e. $\overline{q^i} \geq Q(0), i = 1, 2$. In this region, the standard Bertrand result obtains, with both firms charging their marginal cost and earning zero profits. In order to examine concentration over time, I assume that the firms equally share the market in this region.

Region C contains the remaining capacity states. In this region, it is assumed that the higher capacity firm acts as the high price firm as indicated under the efficient rationing rule.[6] Thus, if firm 1 has more capacity, $\pi^1 = p^1 * \max\{0, Q(p^1) - \overline{q^2}\}$. The price charged by the lower firm (i.e. firm 2) is found by considering what the lowest possible price would be for the larger firm to generate the same profit π_1 if it acted as the low price seller. In other words, it is the smallest root to $\pi_1 - p * Q(p) = 0$. This price is the one that is used by the lower firm. As noted in Besanko and Doraszelski (2004), in region C, the larger firm earns its Stackleberg follower profit, while the smaller firm earns less than the Stackleberg leader profit. In all cases, profits of the larger firm weakly dominate those of the smaller firm.

Capacity State Dynamics

Like Besanko and Doraszelski (2004) and Chen (2009), I assume that total production capacity changes discretely. Discrete changes in total production capacity can be rationalized by thinking of each increase (decrease) coming as the result of the construction (closure) of a plant, which can produce continuously up to some maximum amount.

Two different stochastic forces affect the likelihood of changes in firms' capacity states. First, the amount a firm invests x increases the *probability* that it adds to its total production capacity. Like the bulk of the literature using the Ericson and Pakes (1995) framework, I model the impact of investment on capacity state transitions as in that paper. If some firm i chooses to invest $x^i > 0$, the probability that it adds

[6]When the two firms have equivalent capacity, I make the assumption that firm 1 is the high capacity firm. This assumption does not affect profits.

to its capacity is given by $\frac{\alpha x^i}{1+\alpha x^i}$, where α is a common, exogenously-given measure of investment effectiveness. Thus, firms can only increase their production capacities step-by-step, and investment has a declining marginal impact on the likelihood of increasing the capacity stock.

At first, aspects of this this modeling approach may seem un-intuitive. However, as noted in Besanko and Doraszelski (2004), many things can disrupt capacity expansions in large-scale productive industries. For example, there may be zoning complications, cost-overruns, and/or delays due to materials or labor shortages.[7] Thus, it is reasonable to assign a certain degree of stochasticity to the results of investment decisions. In addition, in capital intensive industries like electricity it often is unlikely that firms will want, or be able, to simultaneously develop multiple new large production facilities.

Second, firms' capacities also change as a result of stochastic depreciation shocks. In keeping with the context of physical capacity, this is modeled as an individual-firm process rather than the market-wide phenomenon in Ericson and Pakes (1995). Each period each firm may suffer a depreciation shock with probability δ. Unlike Besanko and Doraszelski (2004) and Chen (2009), I allow depreciation shocks to affect firms with $\overline{q_0}$ capacity stocks (although firms can never have less than $\overline{q_0}$). Effectively, this makes it more difficult to "re-enter" the market if a firm did not produce in the previous period.

The overall capacity state transition probabilities for a given firm are found by combining the depreciation and investment probability functions. Thus, if firm i is at some capacity state $\overline{q_m}^i$, the probability of it being in state $\overline{q_n}^i$ in the next period

[7] Majd and Pindyck (1987) present a model in which variable investment project completion rates emerge as a result of rational response to changing information.

is given by:

$$Pr(\overline{q_n^i}|\overline{q_m^i}, x^i) = \begin{cases} \frac{(1-\delta)\alpha x^i}{1+\alpha x^i} & \text{if } n = m+1, \\ \frac{1-\delta+\delta\alpha x^i}{1+\alpha x^i} & \text{if } n = m, \\ \frac{\delta}{1+\alpha x^i} & \text{if } n = m-1, \end{cases}$$

if $m \in \{1,\ ...,\ M-2\}$. Since a firm cannot have more than $\overline{q_{M-1}^i}$, when $m = M-1$ the transition probabilities are:

$$Pr(\overline{q_n^i}|\overline{q_m^i}, x^i) = \begin{cases} \frac{1-\delta+\alpha x^i}{1+\alpha x^i} & \text{if } n = m, \\ \frac{\delta}{1+\alpha x^i} & \text{if } n = m-1. \end{cases}$$

Regulatory State Dynamics

As previously stated, I limit variation in the regulatory state to differences in firms' marginal costs. I impose that after the regulatory change firms' costs increase. In the first period of the game, firms learn that the market is subject to regulatory change, but they cannot be surprised by a change that period. The regulatory state subsequently evolves independently of firms' capacities.[8]

The regulatory state's evolution can occur in two ways: as occurring at an uncertain point in time or as occurring at a certain point in time. Both evolutionary methods are Markov processes, but they have different transition matrices P, where $P_{i,j}$ indicates the probability of shifting from regulatory state i to regulatory state j between periods.

In the uncertain case, there are only two states to calculate behavior for: prior

[8]This is an important abstraction. However, it is difficult to endogenize this while plausibly maintaining that the short-run decision of how much to produce is independent of the long-run decision of how much to invest. This separation helps to keep the model analytically tractable and is common in the literature. See Bushnell and Ishii (2007) or Doraszelski and Pakes (2007) for more discussion.

to the regulatory change's implementation (1) and after it has gone into affect (2). As noted, I impose that firms begin in the unregulated state. Conditional on the change not having occurred yet, the probability of moving to the regulated state in the next period is constant and given by $P_{1,2} = \lambda$. The regulated state is absorbing (i.e. $P_{2,2} = 1$). Thus, the long-run probability that the industry will be regulated is 1.

Specifying that the regulatory transition process is this simple is somewhat unrealistic, insofar as it excludes the possibility that the risk of regulatory change increases over time. However, I believe it captures a large amount of the caprice involved in large regulatory changes, the basics of which may be mooted and largely agreed upon many years before the bill is passed. The delay is often a function of personalities and random events affecting stakeholder beliefs.[9] For example, it took almost 10 years of debate in Congress before the Clean Air Act Amendments of 1990 passed.[10] The likely nature of the future regulatory state was constant; only the timing of the change was uncertain.

The simple memory-less formulation employed for the uncertainty case means that the time until the the regulatory change is a geometrically distributed random variable with mean $\frac{1}{\lambda}$ and variance $\frac{1-\lambda}{\lambda^2}$. Therefore, since firms cannot be in the regulated state in the first period, for a given value of λ, the expected period of the change $E(R) = \frac{1}{\lambda} + 1$. I use this information in constructing the transition matrix for the certainty case. Unlike in the uncertainty case, when firm behavior must be estimated for two different states, now there are R behavioral states, even though the number of regulatory regimes remains just two. This is because firms will behave differently in each pre-regulatory change period since the incentive to hold capacity differs as the number of periods that will be spent in the different regimes evolves. The final state

[9]For example, Jacobsen (2010) documents the impact of the release of "An Inconvenient Truth" on carbon emissions, and seems likely to have raised the profile of climate change concerns to a point where nationwide legislation is possible in the near term.

[10]See Lee and Alm (2004) for details.

represents the world once the regulatory change has taken place. The second to last is the preceding period, when firms' marginal costs are still at the unregulated levels, but they know with certainty that productions costs will rise in the following period. Each preceding state represents the equivalent period back to state and period 1, which is when the market learns of the regulatory change's timing. Transition between these states is governed by a deterministic Markov transition matrix. If there are g states, then $P_{i,i+1} = 1$ for all $i \neq g$ and $P_{g,g} = 1$.[11]

Optimal Investment Decision-making

If the market is currently in state $(\overline{q^1}, \overline{q^2}, s)$, then an incumbent firm i must solve an intertemporal maximization problem to determine how much it should invest. I focus on firm 1 for simplicity of exposition.

Let $V^1(\overline{q^1}, \overline{q^2}, s)$ indicate the expected net present value of all future cashflows to firm 1, conditional on its current capacity, its competitor's capacity, and the current regulatory state. $V^1(\cdot)$ is defined recursively as the solution to the Bellman equation:

$$V^1(\overline{q^1}, \overline{q^2}, s) = \max_{x^1} \pi^1(\overline{q^1}, \overline{q^2}, s) - x^1 + \beta E[V^1(\overline{q^1}', \overline{q^2}', s') \mid \overline{q^1}, \overline{q^2}, s, x^1],$$

where β is the common discount factor. The expectation operator $E(\cdot)$ integrates over the probability distribution of all possible states (capacity and regulatory) in the next period. Firm 1's beliefs about its competitor's future capacity state and the future regulatory state are captured by the conditional probability distribution functions $\Pr(\overline{q^2}' \mid \overline{q^1}, \overline{q^2}, s)$ and $\Pr(s'|s)$, respectively. Thus:

$$E[V^1(\overline{q^1}', \overline{q^2}', s')|\overline{q^1}, \overline{q^2}, s, x^1] = \sum_{\overline{q^1}'} W(\overline{q^1}'|\overline{q^1}, \overline{q^2}) \Pr(\overline{q^1}'|x^1),$$

[11] This is a very similar scenario to that considered in Weintraub et al. (2008).

where

$$W^1(\overline{q^1}'|\overline{q^1},\overline{q^2}) \equiv \sum_{\overline{q^2}'}\sum_{s'} V^1(\overline{q^1}',\overline{q^2}',s')\Pr(\overline{q^2}'|\overline{q^1},\overline{q^2},s)\Pr(s'|s).$$

Conditional on beliefs about $W(\cdot)$, optimal behavior reduces to a single agent optimization problem. As shown in Besanko and Doraszelski (2004), and unchanged by the expansion of the number of states in my model, the first-order condition (FOC) for an interior solution to this investment problem is given by:

$$-1+\beta\sum_{m'} W(\overline{q^1_{m'}}' \mid \overline{q^1_m},\overline{q^2})\frac{\partial \Pr(\overline{q^1_m}' \mid x^1)}{\partial x^1} = 0.$$

Since the upper bound of production capacity is chosen to be at or above the lowest capacity where a firm always chooses not to invest, regardless of the states of its competitors, there will not be an interior solution when firm 1 has capacity $\overline{q^1_{M-1}}$. Therefore, I restrict consideration to $\overline{q_m}^1$ where $m \in 1,...,M-2$. Solving the FOC for the optimal investment function gives:

$$x^1 = -1+\frac{\sqrt{\beta\alpha((1-\delta)(W(\overline{q_{m+1}})-W(\overline{q_m}))+\delta(W(\overline{q_m})-W(\overline{q_{m-1}})))}}{\alpha}$$

The second-order condition (SOC) reduces to:

$$-((1-\delta)(W(\overline{q_{m+1}}^1)-W(\overline{q_m}^1))+\delta(W(\overline{q_m}^1)-W(\overline{q_{m-1}}^1))) < 0.$$

As a result, the SOC is satisfied provided a solution to the FOC exists. Therefore, the firm's optimal strategy function will be:

$$x^1(\overline{q^1},\overline{q^2},s) =$$
$$\max\left(0,-1+\frac{\sqrt{\beta\alpha((1-\delta)(W(\overline{q_{m+1}}^1)-W(\overline{q_m}^1))+\delta(W(\overline{q_m}^1)-W(\overline{q_{m-1}}^1)))}}{\alpha}\right)$$

when $\overline{q_m^1}$ is not at the highest level.

Equilibrium and Computation

As is common in this literature, I shrink the state space by restricting attention to symmetric equilibria and exploit the "exchangeability" of firms (see Pakes and McGuire (2001)). The existence of a symmetric pure strategy equilibrium follows according to the arguments laid out in Doraszelski and Satterthwaite (2007), provided an upper bound is placed on production capacity. I follow the majority of the literature drawing on Ericson and Pakes (1995) in solving for the symmetric equilibrium using a variant of the Gaussian algorithm described in Pakes and McGuire (1994) and Pakes et al. (1993).[12] I first solve for the equilibrium when the timing of the regulatory transition is uncertain, obtaining my starting values by solving for the policy and value functions when $N = 1$. These estimates are used as the initial values in computing the equilibrium for the $N = 2$ case. I then solve for the "regulatory certainty" MPE by backwards induction, using the estimates for firms' behavior once the regulatory change has taken place from the "regulatory uncertainty" model as the behavior and value in the "final period." I then solve for firms' value and policy functions in the period prior to the regulatory change, conditional on those values. This process repeats until I have computed the policy and value functions for all R periods.

As uniqueness of the equilibria is not and cannot be guaranteed, it is necessary to check for multiple equilibria. As is common in this literature, I tested for the presence of multiple equilibria by varying the starting points of my estimation procedure, and consistently converged to the same solutions.[13]

[12] All programs were written and run in Matlab 7.8. Details are available upon request.

[13] Many papers employing the Ericson and Pakes (1995) framework and Pakes and McGuire (1994) algorithm have not found multiple equilibria (e.g. Besanko and Doraszelski (2004), Goettler et al. (2005), Chen (2009), Markovich and Moenius (2009)). However, other papers have found them (e.g. Doraszelski and Satterthwaite (2007), Borkovsky et al. (2009), Besanko et al. (2010)). Borkovsky et al. (2009) present evidence that the possibility of entry and exit may increase the likelihood of

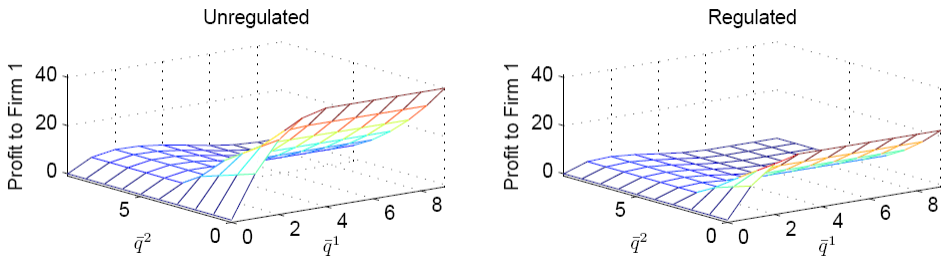

Figure 3.2: Firm 1 Profits

Parameterization

As in Besanko and Doraszelski (2004) and Chen (2009), I assume that each discrete capacity element is a plant capable of producing 5 units of the good. The highest capacity $M-1$ state is 9. Thus, total productive capacity is between 0 and 45. δ, the likelihood of receiving a depreciation shock, is set to 0.3, and α, the parameter in the Ericson-Pakes probability function that affects the likelihood that investment is successful, is set to 0.125. As previously noted, marginal costs in the unregulated state are normalized to 0. I impose that they rise to 1 after the regulatory transition. The intercept of the inverse demand function a is set to 4, while the slope b is set to 0.1.

λ indicates the probability of shifting into the new regulatory state if that has not yet happened. Because the variance σ_R^2 of R is inversely related to λ, I say that markets with smaller values of λ are more uncertain than those with larger. I solve the model for three different values for λ: 0.2 (which translates to $E(R) = 6$ and $\sigma_R \approx 4.5$ periods), 0.1 ($E(R) = 11$ and $\sigma_R \approx 9.5$ periods), and 0.05 ($E(R) = 21$ and $\sigma_R \approx 19.5$ periods).

Baseline Functions

Given the specified demand parameters, optimal single-period production choices can be found for each combination of capacity and regulatory states. The first panel

multiple equilibria.

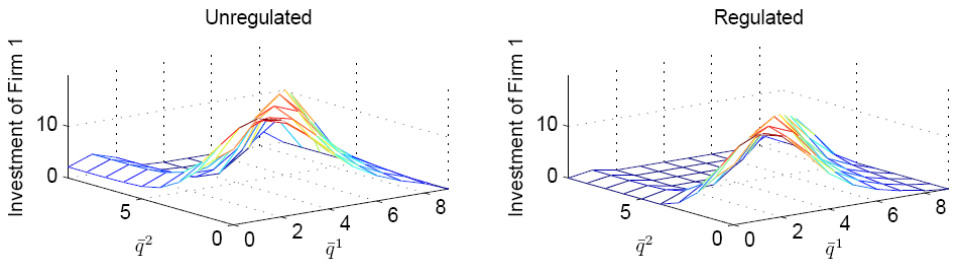

Figure 3.3: Comparing Firm Policy Functions

of Figure 3.2 shows the single-period profits in the "unregulated" state for firm 1 in the market as a function of its own capacity and that of firm 2. Similarly, the second panel shows the single-period profits after the regulatory change has gone into effect. Intuitively, the second panel indicates the same overall patterns observed in the unregulated market only with lower payoffs.

The two panels in Figure 3.3 show the equilibrium investment behavior in the unregulated and regulated states, respectively.[14] Behavior in the two regulatory regimes is qualitatively similar. However, the level of investment is less in regulated markets, because the higher production costs mean that lower levels of production capacity are required. In both regulatory regimes, there is a capacity race dynamic because of the benefits of being the largest firm. This is revealed by the high levels of investment when firms have close to symmetric levels of production capacity.

The graphs in Figure 3.4 show the value (i.e. the discounted stream of net profits) of being in the unregulated and regulated markets in different market structures. Unsurprisingly, they show that the value of being in the unregulated market is markedly higher for all capacity states. They also dramatize why firms engage in capacity races: the payoffs to being the larger firm are precipitously larger.

Another way of understanding the capacity race dynamics can be found in the long-run steady states of the industries under the different regulatory regimes. I con-

[14]Because of the similar parameterizations, the first panel closely resembles panel 4 of Figure 7 in Besanko and Doraszelski (2004). There are mild differences for very low levels of capacity, because Besanko and Doraszelski (2004) rule out the possibility that depreciation affects firms with 0 current capacity stocks.

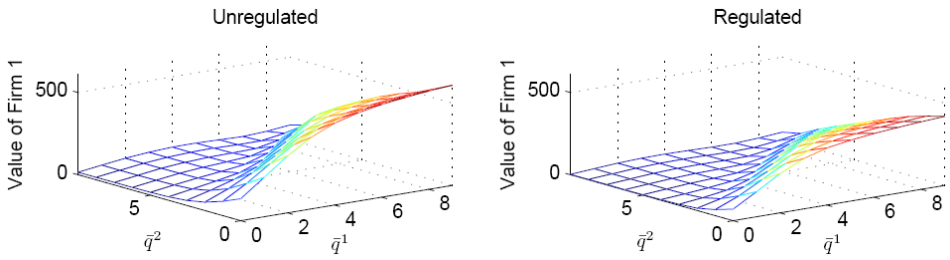

Figure 3.4: Comparing Firm Value Functions

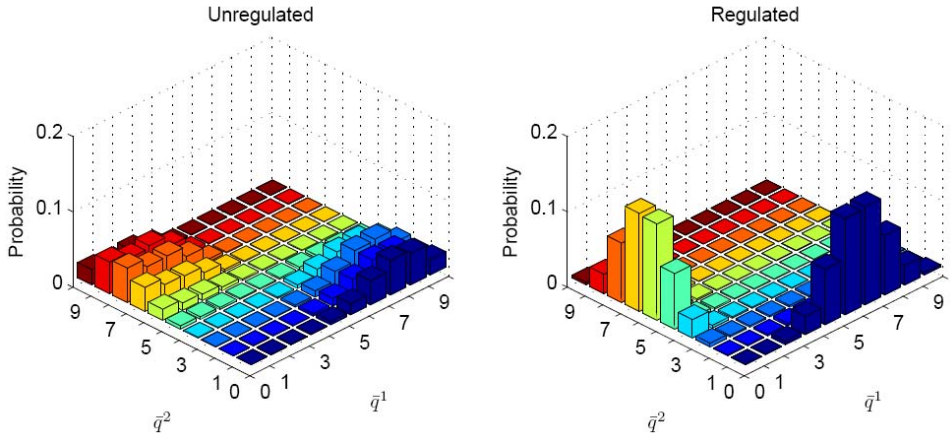

Figure 3.5: Limiting Distributions

struct this long-run steady state using the calculated equilibrium investment functions, which avoids the possibility of simulation bias. Figure 3.5 shows the long-run probability of being in different capacity states under the two regulatory regimes, when strategies are formed in the absence of knowledge of possible regulatory changes. Before the regulatory change, the ergodic distribution is bimodal, and implies that the long-run equilibrium is to have one large firm and one small one. While the limiting distribution is still bimodal after the regulatory change, the equilibrium is now to just have one monopolist serve the entire market. Given the increased production costs, it is not cost effective for a smaller firm to make the necessary investments to remain in the market. Thus, firms in the regulated state engage in intense capacity races to see which firm becomes the monopolist and which "exits."

3.3 Strategic Implications of Regulatory Uncertainty

The Effect of Regulatory Uncertainty on Investment

In this subsection, I present an analysis of how firm investment behavior differs depending on whether or not firms know exactly when the regulatory state will change. I do this by focusing on their policy functions in the period they learn that the current regulatory state will eventually change (i.e. period 1). At this time, firms in both markets have the same expected number of periods in the unregulated state. Thus, variation in their policy and value functions can be attributed to the relative presence of uncertainty. In order to gain insight into how the level of uncertainty affects behavior, I vary $E(R)$. Because the expected value of being in markets with different values of $E(R)$ is not the same, strategies in markets with different values of $E(R)$ cannot be directly compared.

Qualitatively, firms' policy functions when the change's timing is both certain and uncertain closely resemble those observed above in Figures 3.3.[15] Moreover, the results for the different $E(R)$s are intuitive. Because firms expect (know) that they will have more unregulated periods for large values of $E(R)$, they invest more.

However, if one looks closely, there are interesting differences between the results for regulatory certainty and uncertainty across the different values of $E(R)$. These are made clear in Figure 3.6, which shows the difference between the investment functions of firms in certain and uncertain markets for each of the $E(R)$s. When the difference is greater than 0, firms invest more in a given capacity state when they know with certainty when the regulatory change will take place than when they do not. This is the result implied by the standard real options framework, which predicts that firms in uncertain markets delay investment in order to gain information. However, as the Figure shows, I find that in some circumstances firms are *more* inclined to invest

[15]Depictions of the policy functions for certain and uncertain markets under different $E(R)$s can be found in Figure 3.11 in the Appendix.

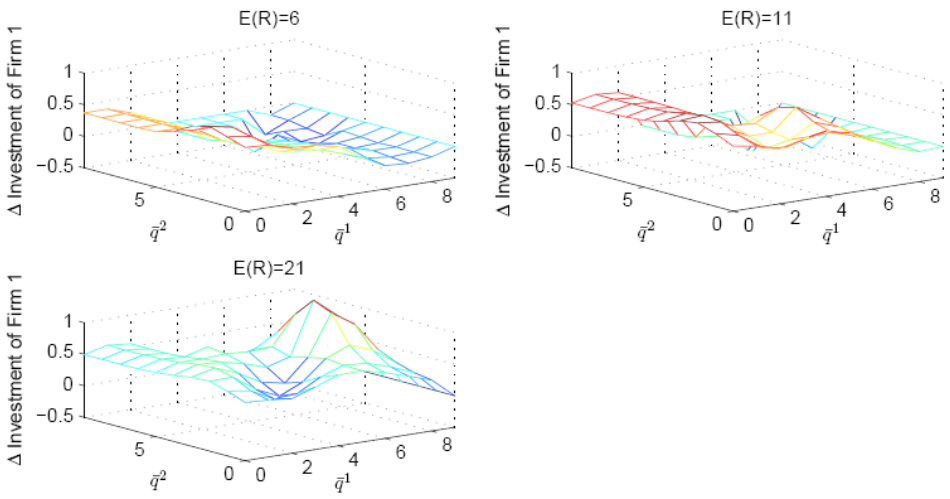

Figure 3.6: Difference in Investment Between Certain and Uncertain Markets

when the future market environment is uncertain.

When the regulatory regime is expected (known) to occur soon (i.e. $\lambda = 0.2 \mapsto E(R) = 6$), I find more uncertain than certain investment when firms have large amounts of capacity. When the regulatory transition is expected (known) to occur in the medium-term (i.e. $\lambda = 0.1 \mapsto E(R) = 11$), the same general pattern is true but for higher values of capacity. In no cases do I find greater investment under uncertainty when the regulatory change is expected (known) to occur in the distant future (i.e. $\lambda = 0.05 \mapsto E(R) = 21$).

The inversion of the standard real options result for firms with large stocks is driven by the nature of the uncertainty, which concerns the timing of a negative shock. The fact that this can be attributed to the nature of the uncertainty is demonstrated by the fact that it occurs even in the monopoly case. This can be seen in Figure 3.7, which shows the equilibrium policies of a monopolist in certain and uncertain markets for $E(R) = 6$. As in the duopoly case, a monopolist with a large amount of capacity will invest (slightly) more when it does not know the exact timing of the change than when it does.

The reasons for this behavior are intuitive. As seen above in Figure 3.2, the profits

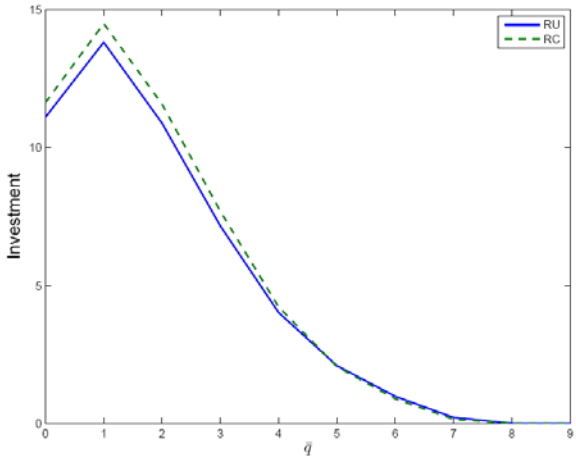

Figure 3.7: Monopoly Investment for E(R)=6

to being in the market fall markedly after the implementation of the Pigouvian tax. Therefore, there is much less incentive to have a large capacity overhang that helps ensure that the random depreciation shocks do not lead to exit. Those firms that know with certainty when the regulatory regime will change make more precise adjustments about when they should begin to restrict investment relative to firms uncertain about the change's timing. For capacities below this threshold, firms that know when the regulatory change will occur invest more than their uncertain counterparts. This is because they know that the transition is far enough away that they want to be sure to keep enough capacity to earn high profits before the policy change. Intuitively, I find that this relative restriction begins at lower capacities when the regulatory change is closer.

As can be seen in Figure 3.6, however, the degree to which a firm invests relatively more or less under uncertainty is also influenced by its competitor's capacity. This reflects the effects of the strategic interaction between firms. As seen in Figure 3.5, in the long-run, there is only room in the regulated market for one firm. Thus, when the regulatory change is (expected to be) close, firms adjust their investment patterns depending on whether or not they have already achieved or still can achieve a dominant position. Their beliefs about the threshold beyond which it no longer makes

sense will vary depending on $E(R)$ and whether or not they know with certainty when the change will occur.

In general, the greatest relative increase in investment by firms in certain markets occurs when firms have low but relatively symmetric stocks of capacity. In this case, firms have an incentive to race to establish themselves as the dominant firm by the time of the regulatory change so that they earn the monopoly profits indefinitely thereafter. Investment by firms in uncertain markets still has a capacity race dynamic – as can be seen in Figure 3.11 in Appendix A – but it is moderately less pronounced because it is not certain that the firm must achieve a dominant position so soon.

Because firms earn the lowest profit when both have very large capacity stocks, the largest reductions in certain investment occur when a firm has a lot of capacity but not as much as its competitor. The smaller firm slows its investments because it realizes that there is little likelihood that it will become dominant, so it makes more sense to earn profits as a low-capacity firm in the remaining unregulated periods. By contrast, firms in similar capacity states that only have an unbiased estimate of when the regulatory change occurs continue investing comparatively aggressively. They do this as there is a reasonable chance of achieving an inversion in the market structure, and there are lopsided payoffs to achieving it.

Although the setting is very different, we can relate these findings to Hartman (1972) and Abel (1983), where assumptions about the convexity of the marginal product of capital produced the opposite prediction of the real options literature. The combination of strategic incentives and the nature of the regulatory change in this setting sharply increase the marginal product of additional capital in some industry structures, which leads to greater investment under uncertainty in some cases. Overall, these results indicate there is no clean comparative static for the effect of regulatory uncertainty on oligopolists. In order to predict how firms will respond to uncertainty, an understanding of the initial market structure is needed.

My results can also be related to previous work on strategic interaction in declining industries. The model utilized here generates results that contrast with those of Ghemawat and Nalebuff (1985), whose model predicts that in a shrinking market, it is the largest firms that exit first. In large part, the difference in the results can be attributed to their modeling assumption that firms must either fully utilize capacity or exit. By contrast, I allow firms to leave capacity idle; moreover, firms can shrink by ceasing to invest to offset the depreciation results. Instead, my results are similar to those of Whinston (1988), who shows that size conveys an advantage in declining markets to multi-plant firms when plant sizes are symmetric. This paper's results on firms' equilibrium policies also resemble, in some ways, those of Besanko et al. (2010), who find multiple equilibria in their assessment of demand uncertainty's impact on investment dynamics. However, in two out of the three equilibria that they uncover, size bestows strategic benefits on firms as seen in this paper.

The Value of Certainty

This subsection considers how firms' value functions differ according to whether or not the timing of the regulatory change is certain or uncertain. Intuitively, the results show the same general relationship as in Figure 3.4.[16] As before, there are differences based on whether the timing of the change is certain or not. Figure 3.8 shows this difference for each possible capacity state for the different values of $E(R)$.

For the most part, the Figure is consistent with the comments of industry experts and leaders that they prefer the regulatory horizon to be clearly defined.[17] However, in some instances, the value of firms is higher when the regulatory change's timing is uncertain. As before, these occur mainly when $E(R) = 6$. I find that firms with

[16]Depictions of value functions in the different markets for different $E(R)$s can be found in Figure 3.12 in Appendix A.

[17]For example, General Electric's CEO, Jeffrey Immelt, in an editorial about climate change regulation states, "All that we ask for - and this will allow us to grow as a healthy, responsible company - is consistency" (Kosterlitz (2009)).

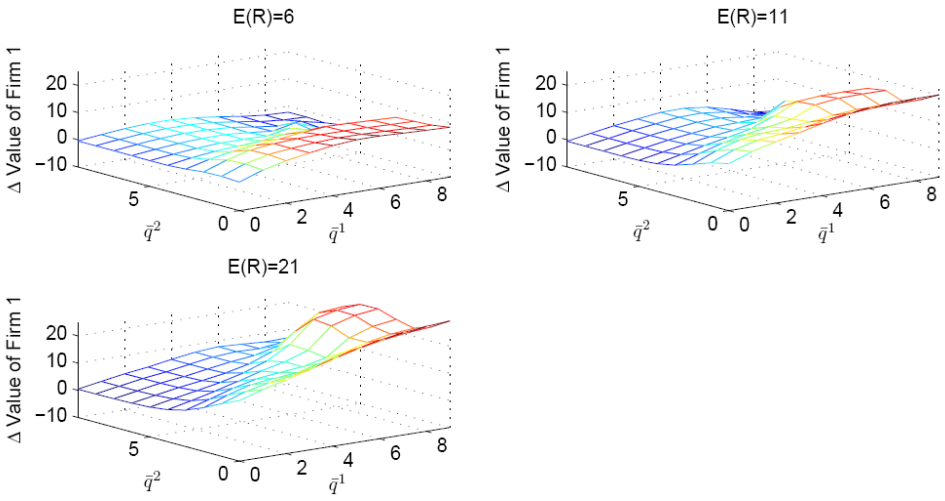

Figure 3.8: Difference in Value Functions Between Certain and Uncertain Markets

zero capacity stock facing competitors with large capacity stocks are worse off when the change's timing in certain. This is consistent with the previous discussion. In such situations, it is virtually certain that they will not be able to invert the market structure and become the long-run monopolist. Similarly, if both firms have at least $\overline{q_7}$, I find that they have lower values in certain markets, which reflects that they are likely to experience multiple periods of 0 profits until depreciation and stochastic investment shocks establish a dominant large firm and an eventual exiting small one.

3.4 Welfare and Regulatory Uncertainty

Having established that uncertainty about the timing of a regulatory change has a significant impact on oligopolists' investment and value functions, I now explore the implications these differences have for market structure and social welfare.

Methodology

I present the average values of a variety of industry performance metrics in different periods t below. I determine these values in the following manner.

First, I determine the starting state. This could be any possible combination of

capacities $\overline{q^1}, \overline{q^2}$ and regulatory regime s. However, my baseline initial state is the ergodic distribution of the unregulated regime shown in the first panel of Figure 3.5. I make this assumption because most regulatory changes occur to mature industries that evolved for many years without grounds for assuming the likelihood or severity of future regulation.[18]

Let E be the vectorized matrix of probabilities underpinning Figure 3.5 that the industry is in any given capacity state. Similarly, let X be the vectorized matrix of values of some industry metric (e.g. profits, investment, concentration, etc.) conditional on the capacity state. Then, the average value of that metric in the first period of the model will be $\hat{x}_1 = E'X$. For any subsequent period t, the average value will be $\hat{x}_t = E'M^{t-1}X$, where M is the Markov transition matrix for all combinations of capacities and regulatory states.

Graphical Analysis

I begin by graphically analyzing differences across the values of $E(R)$ for industry concentration, aggregate industry investment, and aggregate profits.

Figure 3.9 shows the average value of the Herfindahl-Hirschman Index (HHI) at every period for the different modes of regulatory transition. As noted above, the arrival of the Pigouvian tax ultimately leads one firm to leave the market by letting depreciation reduce its capacity stock to 0. Thus, the long-run concentration rate is around 1 – i.e. a monopoly. Figure 3.9 indicates that there are not dramatic differences across values of $E(R)$ for each mode of transition. As with the investment and value functions examined above, however, there are distinct differences between the uncertainty and certainty cases. Consistent with the fact that regulatory changes

[18]I have also explored the implications of choosing other initial states. In particular, I focused on the implications for "new" industries, where both firms start out at $\overline{q_0}$. Intuitively, I find that the average behavioral differences between uncertainty and certainty are smaller, but the same qualitative differences between the two remain. Details on these and other results for different initial conditions are available upon request.

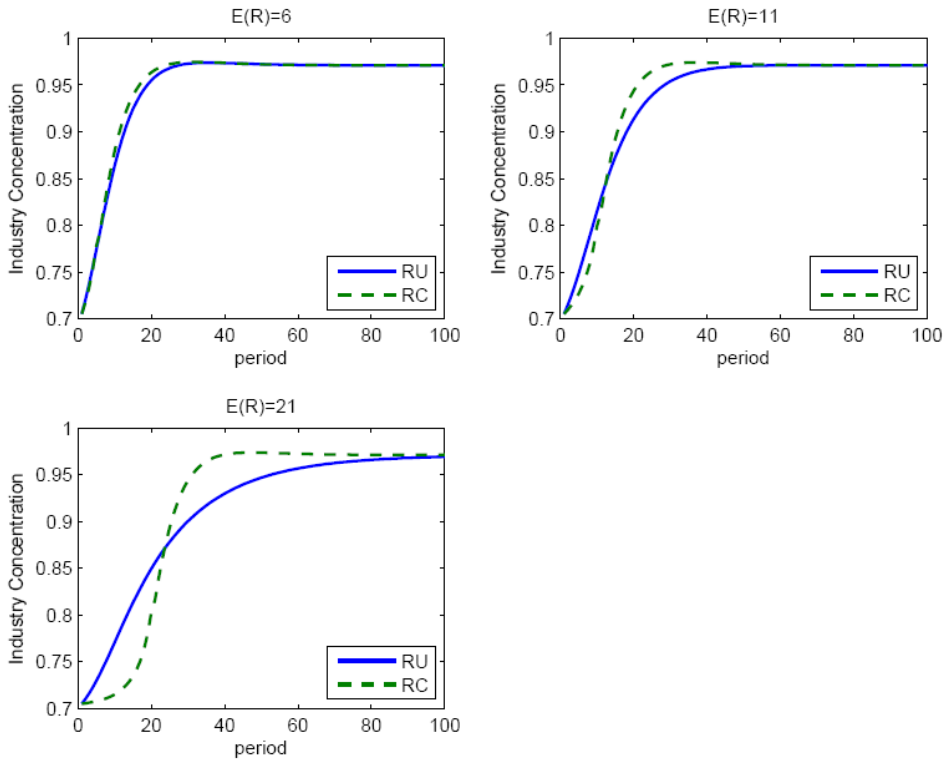

Figure 3.9: Concentration Across Regulatory States

begin occurring immediately in the regulatory uncertainty case, these markets begin to converge to the long-run level of concentration in regulated markets first. By contrast, the regulatory certainty case starts converging later. The reason for this is as follows. Referring to Figure 3.5, it is clear that there is a non-trivial probability that there will be two firms with significant capacity stocks. Until one of them establishes itself as dominant, these markets will thus be more concentrated. However, once this has been established, the markets increase in concentration rapidly, even overshooting the longrun steady state before converging back to it.

The corollaries to the differences in concentration appear in Figure 3.10, which shows the average aggregate industry investment and profits during each period by firms in each type of market. The first column shows average investment patterns in certain markets. When the Pigouvian tax's arrival time is known, average investment is initially higher. This is the period during which firms aggressively invest to achieve

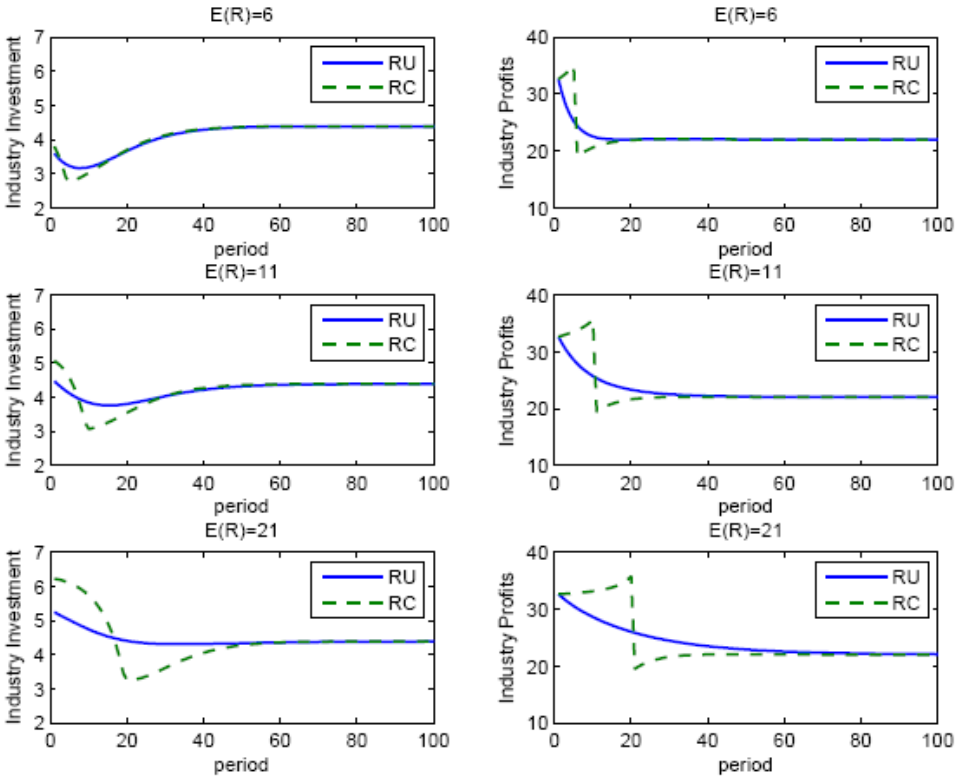

Figure 3.10: Comparing Investment and Profits Across Regulatory States

a position of dominance. Once this has been established, investment falls below the mean level in the uncertain markets until the period of the regulatory change, at which time it begins to rise back to the long-run level for regulated markets.

The second column of graphs in Figure 3.10 shows the variation in cumulative per period profits across the different regimes. When firms know the exact date of the regulatory change, profits spike just before the regulatory state switches. This reflects the "exit" of low-capacity firms' before the switch, a consequence of reduced investment and the depreciation shocks, so that the remaining high-capacity firms earn monopoly profits even before the regulatory change. After the changeover, a brief period of low profits occurs. This reflects the fact that some of the certain markets still contain firms with sufficient capacity that all firms earn zero profits. As expected, profits in the regulatory uncertainty markets display no sharp variations, slowly converging to the always-regulated market average.

Net Present Value Estimates

Having established that significant differences exist in how firms respond to the prospect of certain vs. uncertain regulatory change, the question of cumulative impact remains. I assess this question by calculating net present value (NPV) estimates using the average values considered in the previous subsection and the discount factor β. As in Figures 3.9 and 3.10, I limit consideration to the 100 periods following the discovery that the regulatory state is subject to change. Thus, the NPV of a given welfare statistic x equals $\sum_{t=1}^{100} \beta^{t-1} \bar{x}_t$.

Using this approach, I consider differences in profits, investment, environmental damages, consumer surplus, and total welfare for each of the three values of $E(R)$ being considered. Total welfare is the sum of industry profits and consumer welfare net of environmental costs and investment expenditures. Consumer welfare is straightforwardly calculated using the linear demand curve, and the equilibrium price functions. To determine the environmental costs, I assume that the Pigouvian tax exactly offsets the externality. Therefore, the net present value of the environmental costs may be calculated as the net present value of all production multiplied by the change in marginal costs. The results are shown in Table 3.1. As previously noted, I cannot directly compare results when the value of $E(R)$ is not the same. Instead, I emphasize similarities and differences in the relationships between the different transition modes across the values of $E(R)$.

Examining the NPV estimates, I find that regulatory certainty always produces higher total welfare. Moreover, the relative benefit of certainty increases in the level of uncertainty about the arrival time of the regulatory shock (i.e. it is inversely correlated with $E(R)$). When the arrival time is fairly certain, society can be improved, on average, 3.3 percent by making it definite. However, when the arrival time is quite difficult to predict, total welfare can on average be raised 8.5 percent by making the timing known. Consistent with the analysis of firm policies in Figures 3.6 and 3.10,

Table 3.1: Net Present Values

	E(R) = 6		**E(R) = 11**		**E(R) = 21**	
	RU	**RC**	**RU**	**RC**	**RU**	**RC**
Profits	471.0	477.8	503.8	520.8	542.6	573.5
Investment	72.3	70.9	80.3	79.4	92.2	97.4
Environmental Costs	340.5	341.1	359.9	365.0	385.1	402.0
Consumer Surplus	266.4	269.3	293.0	302.9	326.8	351.2
Total Welfare	324.6	335.2	356.7	379.2	392.0	425.3
% Gain in Total Welfare		3.3%		6.3%		8.5%
% Gain in Investment		-2.0%		-1.1%		5.6%

Table 3.1 indicates that on average the NPV of investment spending is greater under uncertainty than certainty when the regulatory change is anticipated to occur soon. This is true for both $E(R) = 6$ and $E(R) = 10$. Consistent with the analysis above, the NPV results suggest that firms earn the highest net profits when they know the industrial environment's trajectory.

Overall, my results imply that there are real costs to leaving policy uncertain, although the magnitude will vary with the level of regulatory uncertainty. I find that one of the drivers of these costs is that uncertainty about the timing of a regulatory change can lead to *inefficiently large* amounts of investment spending as firms try to position themselves as the market leader in the smaller post-regulation markets. Though it is implausible to imagine that periods of policy uncertainty can be done away with completely, the model's results indicate that policy-makers should keep in mind that firms in concentrated industries rationally respond to uncertainty by modifying their investment strategies. A prolonged debate over comparatively small elements of the ultimate regulatory package may therefore lead to worse outcomes. As a result, sometimes accepting a second best solution may be better than fighting for an optimal approach. The results also offer yet more evidence of the economic costs imposed by weak political institutions, which prevent firms' from making confident forecasts about future market conditions (see, e.g., Henisz and Zelner (2001) and

Wilson et al. (2009)).

3.5 Conclusion

Contributing to a growing literature on how firms cope with both exogenous and strategic uncertainty, this article uses a model based on the Ericson and Pakes (1995) framework to consider how capacity-constrained competitors adjust their investment strategies in response to uncertainty about the timing of a Pigouvian tax. I find that this form of uncertainty has different impacts depending on the level of uncertainty and firms' relative position within the market. Contrary to the predictions of the real options literature, my results show that firms sometimes actually invest more when the timing of the regulatory change is uncertain. This occurs for two reasons. First, knowing when the change will occur allows firms to better calibrate their investment strategies to avoid carrying excess capacity into the regulated world. Second, firms in uncertain markets have a stronger strategic incentive to keep investing in an effort to invert (maintain) asymmetric market structures. By contrast, firms in certain markets are more likely to acquiesce to the status quo.

In addition to comparing firm strategies in relation to uncertainty, I also use the equilibrium policy functions to calculate the impact on social welfare of the mode of regulatory change and whether it varies with the level of uncertainty. The results indicate that total welfare is consistently maximized by fixing the timing of the regulatory change. This suggests that on average total welfare can be increased if policymakers settle for the good rather than holding out for the ideal.

These results have broad implications insofar as they demonstrate that the presence of uncertainty may not have consistent effects across industries or markets, depending on their level of concentration and the nature of the uncertainty. This indicates the need for careful consideration of initial conditions before making predictions about the implications of changes in the level of uncertainty in concentrated

industries.

Although I focus the narrative on regulatory uncertainty, the model could straightforwardly be modified to consider situations where other market primitives are subject to exogenous variation. For example, it could be used to model behavior in contexts where a technological breakthrough is anticipated but not known with certainty; this might be associated with variation in entry or exit costs as well as production cost parameters. Alternatively, the uncertainty might be associated with factors influencing the level of demand. In future work, I plan to explore how the model can be expanded to incorporate a richer set of dynamics such as allowing firms to hold different types of productive assets or invest in "lobbying" efforts that affect the likelihood of the exogenous variation.

Appendix

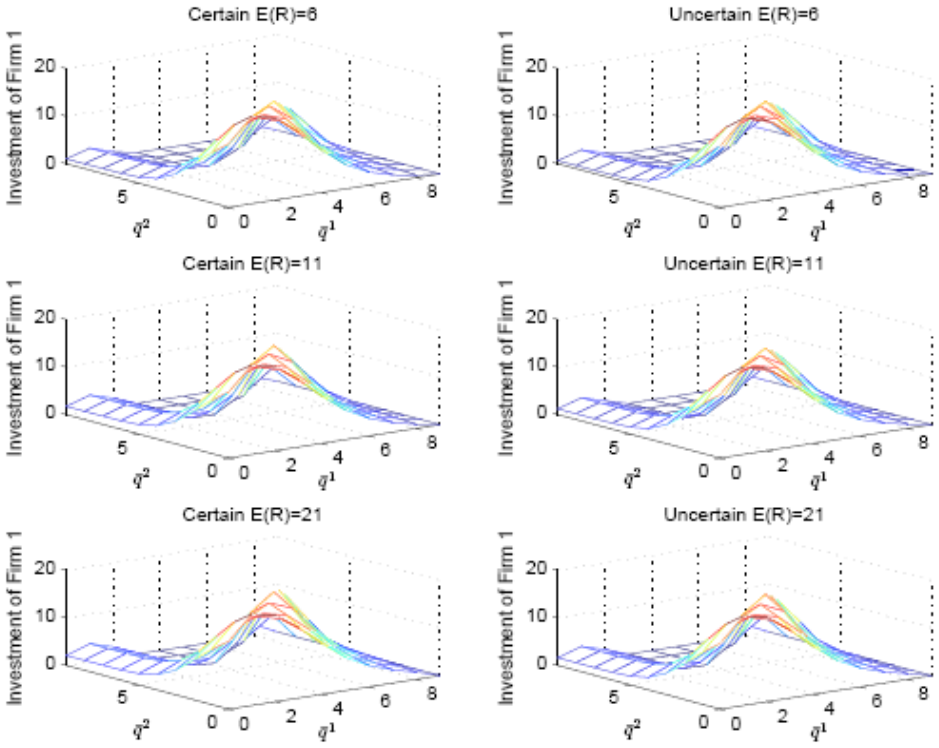

Figure 3.11: Comparing Policy Functions for Certain and Uncertain Markets

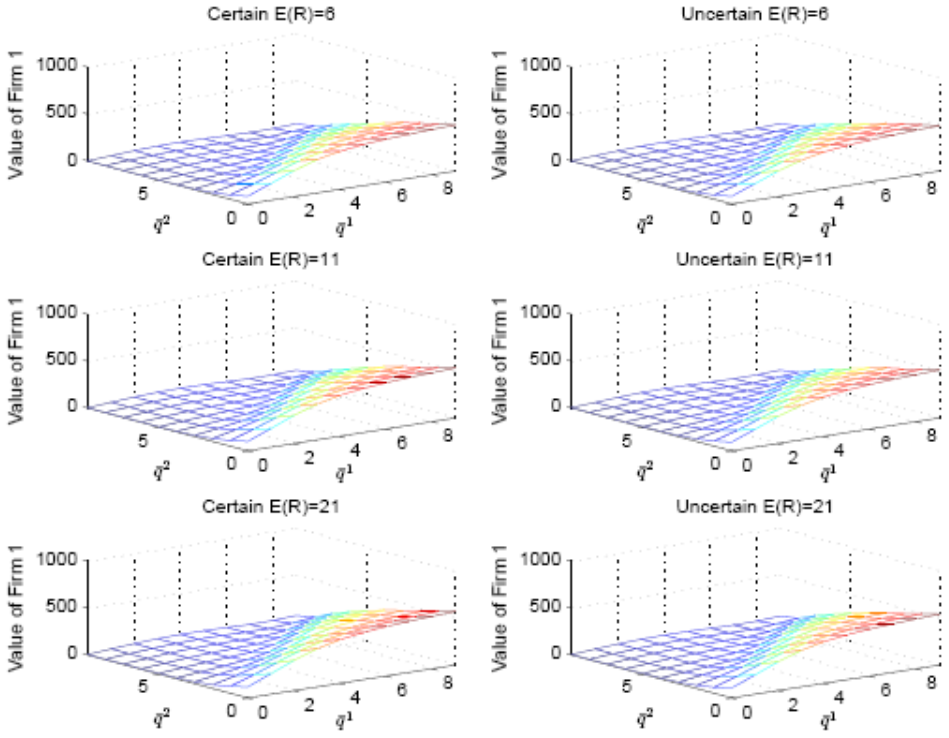

Figure 3.12: Comparing Value Functions for Certain and Uncertain Markets

CHAPTER IV

Brand Effects and Entry Deterrence: An Examination of Spatial Preemption

4.1 Introduction

Industrial economists have long sought to understand the durability of market power (e.g. Bain (1956)). Since the late 1970s, game theory has been used to examine how firms in a variety of settings might reduce competitive pressure by endogenously deterring entry. The core insight of the vast resulting literature has been that an observable decision by an incumbent can deter entry if it provides a credible commitment to compete aggressively in future periods.[1] The specific nature of the entry-deterring decision will vary depending on the nature of competition in the market. For example, Spence (1977) and Dixit (1980) show that when firms compete in quantities, the desire to deter entry creates incentives for capacity investment above and beyond what would occur if firms' decisions were not observable. Analogously, in markets where firms compete by offering differentiated products, Schmalensee (1978) and Eaton and Lipsey (1979) show that incumbents may deter entry by pre-emptively introducing new goods into the product space. Such "spatial preemption" deters entry because the entrant's product will not be able to attract enough consumers to

[1] See section 1 of Wilson (1992) and chapter 8 of Tirole (1988) for seminal contributions to the industrial organization literature.

offset their fixed costs of entry.

Despite strong theoretical predictions, however, the empirical evidence for entry deterrence has been ambiguous, especially for spatial preemption.[2] In some instances, it seems clear that firms are not engaging in entry deterrence, and there may even be a first mover *disadvantage* (e.g. Johnson and Parkman (1983), West (1992), Burton (1994)). In other cases (e.g. Stavins (1995), Berry and Waldfogel (2001)), the evidence is strongly supportive. Moreover, Smiley (1988) finds that managers of firms with mature products attempt to limit entry by filling all product niches.

In this paper, I argue that incorporating consumer heterogeneity and brand loyalty may explain the disconnect between the strong theoretical and ambiguous empirical literatures. Both factors have emerged as important stylized facts in recent empirical work on differentiated product demand (e.g. Berry et al. (1995)) and have begun to be incorporated into new theoretical models of differentiated product competition (e.g. Rotemberg (2010)).

I begin by presenting a game-theoretic model of entry deterrence that allows brand affiliation to heterogeneously affect consumers. The model shows that preemption will be harder to sustain as consumers are more influenced by branding. This occurs because the presence of a brand identifier in consumers' utility functions makes the cross-price elasticities higher for products from the same firm. Thus, brand awareness amplifies within-firm cannibalization, which lowers the benefit to an incumbent of adding an additional product. The model indicates, however, that firms can soften this cannibalization through "sub-brand proliferation" strategies, as suggested by Schmalensee (1978).

I test the model's predictions about spatial competition using data on the Texas lodging industry. With high margins, large multi-"product" oligopolists, and high levels of concentration, it seems natural to expect entry deterrence to occur in this

[2]See Lieberman and Montgomery (1988) and Geroski (1995) for surveys of the early empirical literature.

industry. However, lodging companies also spend considerable time and effort building up consumers' valuations of their brands.[3] Consistent with my model's predictions regarding the impact of large brand effects, I find little evidence that large hotel brands engage in preemption. Instead, the data show that, on average, incumbent brands accommodate entry from new brands, as well as expansion by other incumbents with smaller portfolios. This result is robust to explicitly controlling for the intensity of the threat of entry (see, e.g., Dafny (2005), Ellison and Ellison (2007), Goolsbee and Syverson (2008)).

I further test the theoretical model by exploiting data on each hotel's revenues. The model indicates that the reason preemption does not take place in the presence of strong brand preferences is that cannibalization is particularly pronounced. I test this implication by looking at the impact of market structure on individual hotel reviews. I find that the absence of spatial preemption is consistent with much larger within-brand than inter-brand competition. On average, the presence in a market of another hotel affiliated with the same brand leads to a 17.5 times larger reduction in revenues than a hotel affiliated with a competing brand. This suggests that even if affiliated hotels compete more "softly" with each other in price, consumers' brand preferences mean that the brand largely splits the same pool of customers. Also, consistent with the model's predictions, the data indicate that brands reduce the extent of intra-brand cannibalization through the use of sub-brands. Thus, the presence of a hotel of the same sub-brand has twice as negative an impact as one that is from a different sub-brand.

One of the main advantages of focusing on the hotel industry is that unlike the majority of the retail sector, local hotel-owners are not restricted to working with just one franchisor. Reframing the model to consider the choices of the local owners sug-

[3]See, e.g., the articles and discussion on the industry trade website: http://www.hotelmarketing.com. Additionally, many hotel brands are ranked in the annual "Superbrands" issue in *Brandweek*.

gests that these decision-makers should be able to deter entry by other local owners through the introduction of new hotels associated with new brands. This mitigates cannibalization and fills up the product space more effectively than a decision-maker restricted to a single brand could. Unfortunately, changes in individual owners' portfolios are too hard to track in the data to permit explicit tests for spatial preemption. Instead, I present evidence that owners' new hotels are affiliated with new brands. This result does not demonstrate preemption, but is consistent with that type of behavior.

Overall, the empirical analysis of the Texas lodging industry support the theoretical model's predictions about the relationship between branding and spatial competition. More generally, the paper has implications for where scholars and practitioners should expect entry deterrence strategies to be effective. It indicates that in industries like lodging or fast-food, where brand affiliations play a large role in determining consumer interest, spatial preemption is unlikely. By contrast, when consumers are unaware of or unaffected by products' brands, as in radio markets or breakfast cereals, spatial preemption may be sustained. These predictions appear broadly upheld by other papers in this literature.

The paper proceeds as follows. Section 2 presents the theoretical model and its empirical implications. Section 3 describes the institutional details of the lodging industry and the data used in the empirical analysis. Section 4 discusses the econometric approach to looking at lodging companies' entry and expansion decisions, and then presents the main results of the empirical analyses of this behavior. Section 5 extends the empirical analysis, examining the impact of market structure on hotel revenues as well as the behavior of hotel owners. Section 6 concludes and suggests possible extensions to the analysis.

4.2 The Model

4.2.1 Background

In an influential paper, Judd (1985) provides a theoretical foundation for understanding the uneven evidence for spatial preemption. Using a duopoly model with two product segments and allowing for the possibility of exit, he shows that preemptive expansion by the incumbent into both product segments is not always credible. Depending on the intensity of inter-segment competition, an incumbent with products in both segments may withdraw from an entered segment, because intense competition there could cannibalize sales from the segment where the incumbent still had a monopoly. In such circumstances, spatial preemption by the incumbent into both segments would not be credible. Thus, Judd (1985) suggests that cannibalization is the key to understanding when spatial preemption will occur. However, the paper does not offer intuition for predicting when cannibalization will be so pronounced as to make entry deterrence unprofitable for incumbents.

I argue that recent work in empirical industrial organization does provide such intuition. Whereas the early theoretical literature on preemption used one-dimensional models of the product space (e.g. Hotelling (1929), Salop (1979)), the growing structural demand estimation literature (e.g. Berry et al. (1995)) has exploited econometric methods that allow the product space to be multi-dimensional.[4] In these models, consumers are assumed to derive utility from different goods based on those goods' "portfolios" of characteristics. Moreover, different consumers are allowed to have heterogeneous tastes for different product characteristics (see, e.g., Berry et al. (1995), Train (2003)). For any given consumer, the products whose portfolios of characteristics lead to similar levels of utility will be closer substitutes. Across a variety of industries, the empirical literature on demand for differentiated products has con-

[4]See Anderson et al. (1992) or Train (2003) for surveys of the methods used to estimate these demand models.

sistently found that branding is one of the most important characteristics affecting consumer utility and, therefore, product demand.[5]

Intuitively, the relative magnitude of consumers' brand preferences can help explain when cannibalization will be particularly pronounced. When the utility consumers derive from goods is very affected by their brand, the payoffs to adding an additional identically-branded good will be smaller, ceteris paribus, because it will attract fewer additional consumers than if it had a different brand. This will have the effect of exacerbating the cannibalization effect. Moreover, the close similarity between two identically branded products leaves comparatively abundant space for entry. Thus, when branding is particularly important, spatial preemption is less likely to take place.

Below, I formalize this intuition using a model of strategic product introduction.[6]

4.2.2 Model Overview

My model is a version of the standard three-stage game used in many papers on the subject (e.g Judd (1985), Ellison and Ellison (2007)).[7] To make the connection with the following empirical section straightforward, I discuss the model in terms of hotels.

I consider markets with two potential competitors: the incumbent I and the entrant E, both of which are brands known to consumers. The brands are rational and

[5]See discussion and extensive citations in Hui (2004), Goldfarb et al. (2009) or the recent review by Keller and Lehmann (2006). These findings are now being incorporated in theoretical work (e.g. Tadelis (1999), Rotemberg (2010).

[6]This is not the first paper to incorporate (random) brand preferences into a model of oligopolistic competition. Similar to Judd (1985), the literature has considered the extent to which brand-linkages affect the extent of firms' diversification (e.g. Katz (1984), Gilbert and Matutes (1993), Desai (2001)). These papers demonstrate that the presence of brand effects alters the length of firms' product lines. However, none sheds light on the specific issue of how they impact the credibility of preemption.

[7]For simplicity, I abstract from the evolution of exogenous demand conditions. However, the demand model I employ would allow for straightforward incorporation of these issues or additional variation in the product space. Moreover, the model could easily be extended to a richer setting that allows for variation in the costs of exit and entry (e.g. Pakes et al. (2008)). However, I believe that little additional intuition would be gained from the added complexity.

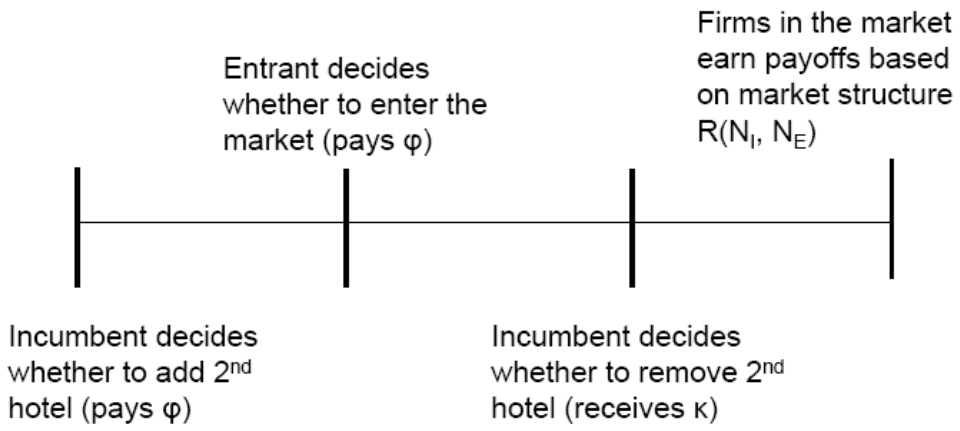

Figure 4.1: Timing of events in the game

foresighted, and they make decisions about investment (and disinvestment) sequentially. Figure 4.1 shows the timeline of their decisions. First, the incumbent, who already has one hotel in the market, decides whether to add a second hotel. Second, the entrant has the option of opening a single hotel of its own. When opening a new hotel, both brands pay a non-negative fixed entry cost ϕ. Third, and finally, the incumbent has the option of closing its new hotel. If the incumbent closes the hotel, it receives its fixed scrap value κ.[8]

Once the incumbent has made its disinvestment decision, the market structure is fixed. Both brands then choose the prices they wish to charge at their various hotels.[9] They subsequently earn the profits implied by the market structure (N_I, N_E), where N_i represents the number of hotels in the market affiliated with firm i.

I assume that brands play sub-game perfect strategies. Thus, the incumbent will not open two hotels if it knows that it will close one in the event that entry occurs. Similarly, if the market can only support two hotels and the incumbent will not withdraw one hotel from the market after entry, then the entrant will not challenge the incumbent if it opens two hotels.

[8]It is reasonable to allow κ to be negative. In this case, κ would represent an exit cost, which might occur if there are clean-up costs such as exist in some manufacturing industries.

[9]Because the products are horizontally differentiated, an incumbent with two hotels will charge the same price in both.

4.2.3 Consumer Demand and Firms' Variable Profits

Demand for lodging stems from a mixed (i.e. random-coefficients) logit demand system (see, e.g., Train (2003)). The mixed logit model permits product characteristics to heterogeneously affect consumer utility, which I use to account for variation in consumers' preferences for firms I and E.[10] All potential consumers in the market maximize their utility by selecting whether to stay in a hotel or take the outside option. The utility that consumer i gains from choosing a given hotel j affiliated with brand B is:

$$V_{i,j} = \delta - p_j + \mu_{i,B_j} + \epsilon_{i,j}, \tag{4.1}$$

and:

$$V_{i,o} = \mu_{i,o} + \epsilon_{i,o} \tag{4.2}$$

where o is the outside option. δ indicates the baseline benefit to all consumers of staying in a hotel and is common to all hotels. p_j is the price charged at hotel j. μ_{i,B_j} captures consumer i's tastes for brand B.[11] All the μ represent independent draws from identical distributions, which have variance parameter σ^2. Note that while the draws will be independent across consumers and firms, hotels associated with the same brand will share the same μ.[12] The $\epsilon_{i,j}$ are independent draws from an extreme value distribution.

The different choices' market shares are determined by integrating out all of the

[10]The mixed logit demand system also has the benefit of extending straightforwardly to n-firms, unlike previous models of differentiated competition endogenizing brand linkages (e.g. Gilbert and Matutes (1993)).

[11]For the sake of simplicity, I assume that consumers are homogeneous in how they perceive the value of lodging and its price.

[12]It is worth noting that while I assign a utility shifter to the outside option, this could be normalized to 0 with no qualitative effect on the results.

stochastic brand utility terms. This means that the market share of each hotel j is:

$$\begin{aligned} S_j &= \int \frac{\exp V_{i,j}}{\sum_j \exp V_{i,j}} f(\mu) d(\mu) \\ &= S_j(p_j, p_{-j}), \end{aligned}$$

where $f(\mu)$ is the joint density function of consumers' random brand utility shifters. Thus, hotel j's share of the market as a function of its own price (p_j) and the prices of all other hotels in the market (p_{-j}).

I assume that marginal costs are 0, but being in the market requires payment of a fixed cost f in each period.[13] Thus, normalizing the size of the market to 1, the profit of hotel j affiliated with brand B can be written as:

$$\begin{aligned} \Pi_j &= p_j * S_j(p_j, p_{-j}) - f \\ &= p_j * \int \frac{\exp V_{i,j}}{\sum_j \exp V_{i,j}} f(\mu) d(\mu) - f. \end{aligned}$$

While the mixed logit formula has the advantage of allowing me to account for important stylized facts like the role of branding and consumer heterogeneity, the presence of the random brand utility shifters (i.e. the μ) means that there are no analytic solutions for elements of interest (e.g. optimal prices, profits). Nevertheless, the consequences of the demand system (explored through numerical simulations) are intuitive. As the variance of μ increases, each firm will have more market power, because the share of the population that has very strong preferences for their brand (and low valuations for the alternatives) increases. This allows them to charge higher prices and earn higher revenues, all else equal. However, it also increases the number of people for whom branding trumps most other considerations, and who will not find hotels associated with one brand substitutes for another.

[13] As noted in Kalnins (2006), marginal costs are very low in the hotel industry relative to fixed costs, justifying this abstraction.

4.2.4 Multiple Outcomes

Depending on the model's parameterization, different equilibrium market configurations are possible. For example, for some combinations of the parameters, a market will not be able to sustain more than the original hotel. In other markets, three hotels could be sustained. In the remainder of this section, I focus on the interesting case when the market can only support two hotels, regardless of which brands they are affiliated with.[14]

Specifically, I now examine how variation in the parameters affects the threshold where preemption (i.e. opening two hotels) by the incumbent is credible. When these threshold conditions are violated, preemption will not be sub-game perfect, and the incumbent will only open one hotel, thereby allowing entry.

4.2.5 Branding and Spatial Preemption

Assuming that a single decision-maker chooses the prices of all the incumbent's hotels to maximize combined profits, entry deterrence will not be credible (and therefore will not be attempted) when it is more profitable for the incumbent to remove one of its two hotels from the market once it sees that the entrant was not deterred. This occurs when:

$$\begin{aligned} R^I(2,1) - 2f &< \kappa + R^I(1,1) - f \\ R^I(2,1) - f &< \kappa + R^I(1,1), \end{aligned} \tag{4.3}$$

where $R^B(\cdot)$ represents the revenues earned by brand B conditional on the market's structure. The first term inside the parentheses in $R^B(\cdot)$ indicates the number of hotels affiliated with the incumbent, and the second indicates the number affiliated with the entrant. Equation (4.3) shows that entry deterrence will not occur when

[14] Judd (1985) discusses the other cases.

the profits of sharing the market equally net of exit costs are greater than the profits from operating two hotels in a three hotel market net of the fixed cost of operating one hotel.[15]

f and κ affect the viability of entry-deterrence in straightforward ways. As the fixed cost of operating a hotel increases, the incumbent is less able to credibly deter the entrant. Similarly, as scrap values increase, the region in the parameter space where preemption occurs shrinks, because exiting the market becomes more attractive.

The model of consumer demand employed here also affects the viability of entry deterrence. Rewriting Equation (4.3) as $R^I(2,1) - R^I(1,1) < f + \kappa$ shows that as the difference between the incumbent's revenues when it has 2 hotels versus 1 hotel falls, preemption becomes less credible. Because of the model of the product space, I cannot prove analytically that this difference shrinks as σ^2 increases. However, numerical simulations show that this is the case. As firms focus more on the segments of the population that have strong preferences about branding, which they do to extract these consumers' surplus, there is less scope to attract new consumers, who would not have already stayed at the original hotel. Thus, introducing a single new hotel into the market will do little to fill up the product space, meaning that the viability of entry deterrence is declining in σ^2.

Region I of Figure 4.2 shows the relationship between $\frac{f}{R(2,1)/2}$, $\frac{\sigma^2}{\delta}$, and the viability of entry-deterrence for a specific parameterization of the model. It illustrates that as the relative importance of brand-preferences increases, the magnitude of the per period fixed costs (relative to per hotel variable profits) needed to make preemption non-credible falls. The X-axis captures the ratio of σ^2 to δ, while the Y-axis is the ratio of the per period fixed cost f to the per-hotel revenues received by the incumbent in a market with 2 incumbent hotels and 1 entrant. In all cases, $\delta = 3$ and $\kappa = 0$.

[15]This is largely analogous to Theorem 1 (i) in Judd (1985).

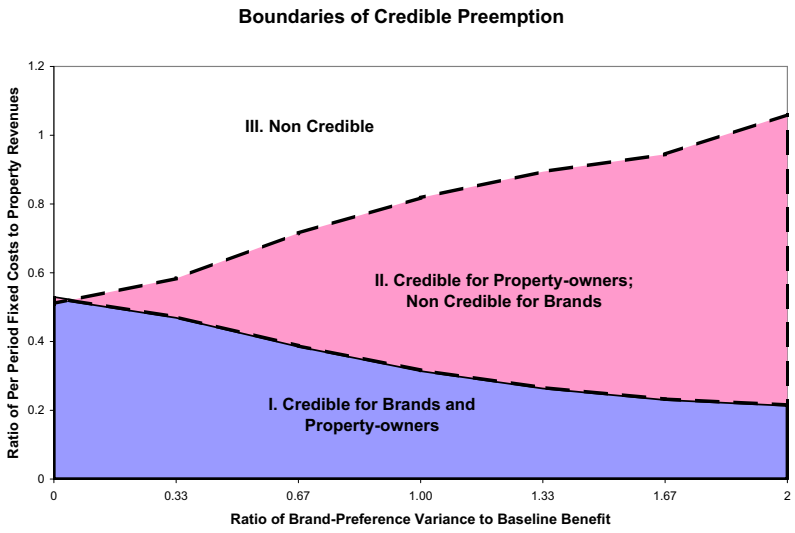

Figure 4.2: Regions of credible and non-credible preemption

4.2.6 Model Implications

Though simple and stylized, the duopoly model presented above provides three testable implications.

First, it shows that brands' ability to defend market power through spatial preemption falls as consumers' tastes for brands becomes more heterogeneous (i.e. as σ increases). This occurs because of the large cannibalization effect of introducing an additional hotel, which will increasingly outweigh the benefits of "softer" price competition with an affiliated unit. Thus, it is unlikely that spatial preemption will be detected in industries where consumers choose products in large part based on their brand affiliation. Moreover, it implies that, ceteris paribus, intra-brand competition will have larger negative effects on a hotel's revenues than inter-brand competition.

Second, it is straightforward to extend the intuition of the model to show circumstances where spatial preemption would be easier. For example, Schmalensee (1978)

discusses the ability of firms to create new horizontally differentiated "sub-brands" with distinct identities of their own to leverage market power. Allowing consumers' utilities to be affected by sub-brands' affiliations changes Equation (4.1) to:

$$V_{i,j} = \delta - p_j + \mu_{i,B_j} + \alpha_{i,b_j} + \epsilon_{i,j}, \tag{4.4}$$

where b indicates the sub-brand of brand B that hotel j is affiliated with, and α its associated effect on consumer i's utility. Like the μ, the α are independent draws from a known distribution. The fact that the α will differ for each consumer across sub-brands makes it easier for firms to engage in preemption, because it reduces the cannibalization effect.[16]

Third, in industries where franchising relationships are common, such as lodging, the model has different implications if the local hotel-owners can offer products affiliated with different brands. Regions I and II of Figure 4.2 indicate the relationship between $\frac{f}{R(2,1)/2}$, $\frac{\sigma^2}{\delta}$, and the viability of entry-deterrence for hotel-owners affiliated with two different brands. The Figure shows that as the relative importance of brand-preferences increases, the magnitude of the per period fixed costs (relative to per hotel variable profits) needed to make preemption non-credible *increases*.[17] Thus, the model predicts that owners of multiple hotels should associate them with different brands, and it should be easier for them to preempt entry than for single brand firms. This is because, unlike brands, the local owners can spread their offerings apart in the product space, reducing cannibalization.

[16] Additionally, if the assumption that the different firms' μ are iid is relaxed, then if the mean of the incumbent's μ is higher, it will also be more likely to add new units as its goods are viewed as more desirable on average. For example, Thomadsen (2007) shows that asymmetries in consumer valuations cause McDonald's and Burger King to have different geographic location strategies. Similarly, if consumers had heterogeneous preferences about different segments of the market that the different products could be placed in, then deterrence would be easier to sustain.

[17] For the numerical analysis used to create the Figure, each hotel receives an independent μ. Thus, there are assumed to be at least 3 separate firms.

4.3 Industry and Data Description

4.3.1 The Lodging Industry

According to Standard and Poors Industry Reports (2008), the American lodging industry had annual pre-tax income of between $14 and $29 billion on revenues of between $100 and $145 billion over the previous ten years.

Data compiled by Hotel and Motel Management (2004) show that 50% of all hotels in the country are affiliated with 10 large brands, which often own multiple sub-brands.[18] This is true within, as well as across, quality segments. For example, the Marriott Hotels brand includes the Fairfield Inn and Courtyard sub-brands, both of which are in the mid-level segment. As noted above, the presence of multiple sub-brands should facilitate spatial preemption. Moreover, in many cases, hotel markets are small and isolated, capable of only supporting a few hotels. The high degree of concentration, existence of sub-brands, commonality of small markets where strategic behavior would be most likely, and large margins would all be consistent with the prevalence of spatial preemption.[19]

However, product differentiation may also explain the high profitability of the industry. While one important source of differentiation is quality (see, e.g., Mazzeo (2002)), branding also plays a large role in differentiating hotels. Consumers' exogenous preferences for different brands are amplified by brands' marketing strategies.[20] These are large and sophisticated as evidenced by the space allotted to their discussion in firms' annual reports.[21] As a result, many hotel brands appear in *Brandweek*'s

[18] See Kalnins (2006) for a recent survey of the economics of the US lodging industry.

[19] Moreover, lodging is a franchising industry, which means that hotels affiliated with the same brand in the same market often have different owners. Hadfield (1991) argues that such vertical separation may make spatial preemption credible when it might otherwise fail. This story is discussed more fully in Section 5.

[20] Such efforts are seen as particularly critical as a result of the substantial convergence of standards within segments. For example, Shoemaker and Lewis (1999) state that in a survey of high-end hotel managers, many could not identify the brand of pictured hotel rooms – even for their own hotels.

[21] For example, Accor's 2008 Annual Report (p. 16) discusses how brand development and revitalization are a large part of its strategy in the hospitality sector.

annual "Superbrands" issue listing of the most valuable brands. In addition to traditional forms of marketing, recent industry innovations include loyalty programs (see, e.g., Shoemaker and Lewis (1999)). Like frequent flyer programs, these programs are designed to help brands overcome the increasing standardization of quality and services within a segment (see Klemperer (1987)). Compounding the rise of loyalty programs, many brands have developed internet booking services for all of their affiliated hotels. Thus, a traveler can easily check the prices for all of a given network's hotels in a given market.

All of these factors should create the common brand effect used in the theoretical model presented above, which should give the brands market power by differentiating them but inhibit their ability to engage in spatial preemption.[22]

4.3.2 Data Description

To test the predictions of the model above, I use data from the Comptroller of Public Accounts (CPA) for Texas.[23] For each hotel that operated between 2000 and 2008, the CPA provide data on the hotel's owner, capacity (in rooms), and revenues. The hotels are identified by name, city of location, and address.[24] Although originally reported at quarterly and monthly intervals, I aggregate the data up to yearly observations on the grounds that it takes that long to decide to and then build a new hotel. In order to focus on the hotel and motel market (as opposed to the boutique inn and bed and breakfast segment), I exclude observations of hotels with less than 30 rooms.

[22]It is a stylized fact in the industry that the combination of marketing and inherent tastes leads consumers to have very strong brand preferences. As an industry professional explained to me, consumers may not exactly know why they prefer certain brands, but their behavior indicates they will pay a significant premium for their preferred brand.

[23]Several other papers (e.g. Kalnins and Chung (2004), Kalnins (2004), Conlin and Kadiyali (2006), Suzuki (2009)) interested in studying differentiated competition in the hotel industry have also used various periods of CPA data.

[24]In many instances, I found that the reported name or address for a given hotel might vary slightly from one year to the next. I systematize name and address conventions over time as failing to account for such variation would lead to an inaccurately large estimate of the churn in hotels.

Like Mazzeo (2002), I use cities rather than zip-codes as the relevant market definition as even cities of modest size often have more than one zip code. Moreover, this follows the convention adopted by the industry insofar as hotels advertise themselves based on their city of location, and guidebooks organize their reviews around cities. However, a city-based approach to market definition has important drawbacks. It assumes that within a market the location of different hotels does not matter. In small locations this assumption may hold, but in larger markets, where it may be time-consuming to get from one point to another, it will fail. Additionally, using cities assumes that there are no spillover effects across markets. In many cases, this also may not hold.

Following Bresnahan and Reiss (1987), I focus on geographically isolated markets of modest size. I find such markets in the following manner. First, I use Google Earth to determine the "centrum" of each city in the CPA data.[25] Second, I calculate the distance between each of the centrums using the Great Circle methodology. Third, I discard those cities whose centrums are less than 10 miles from that of their nearest neighbor or less than 50 miles from the major economic hubs of San Antonio, Austin, Dallas, El Paso, and Houston. Then, I drop the cities that never had a population of more than 1,000 people during the sample period according to U.S. Census data; I also drop the resort cities of South Padre and Corpus Christi.[26] This leaves a total of 183 cities, with 1,198 different hotels and 7,286 hotel-year observations. Figure 4.3 shows the locations in Texas of all markets in the sample.

I differentiate hotels in two dimensions: quality and (sub-)brand affiliation. First, I match the hotel names to an author-constructed data set containing the names of the

[25]I define the centrum to be the latitude-longitude point that the software converges to when the city is entered into the search bar.

[26]The Census data can be downloaded from the Census at factfinder.census.gov. I exclude the coastal resort cities as they had vastly more hotels than all other markets of similar size. As in Bresnahan and Reiss (1987), I explored whether cities near the borders with Mexico or other states are outliers. I found that excluding these cities did not affect the results, so I have left them in the sample.

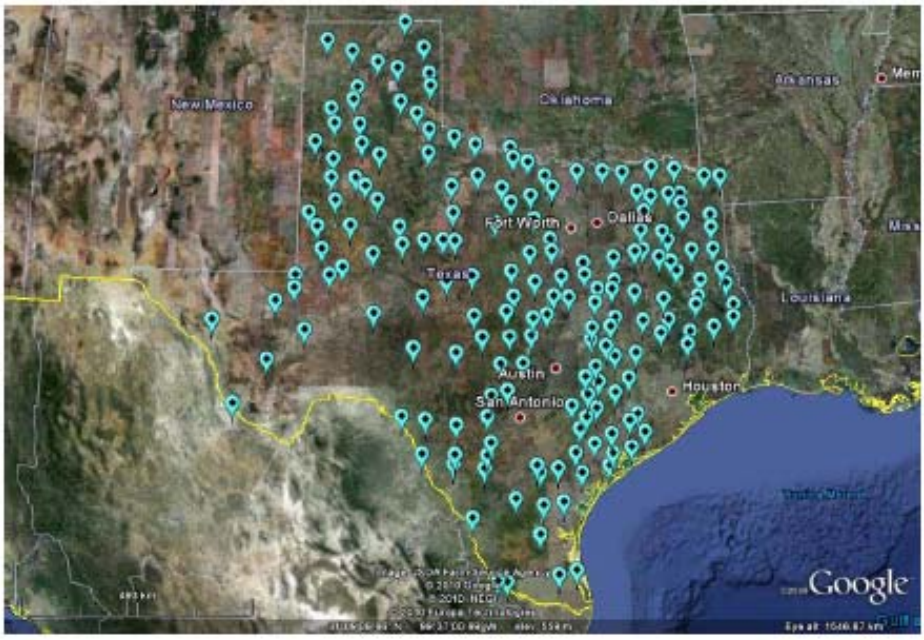

Figure 4.3: Map of Market Locations in Texas

national sub-brands and their parent brands. Of the 7,286 hotel-year observations, 37 percent are affiliated with sub-brands belonging to 17 different national brands.[27] To control for quality, I follow Kalnins and Chung (2004) in assuming that hotels have the average quality rating of their sub-brand, which I determine using the American Automobile Association's (AAA) Texas Tourbooks.[28] Table 4.1 shows the number of hotel-market-period observations associated with each of the brands and their quality tiers, where the high quality tier is composed of all brands with average ratings of between 2 and 3 stars.[29]

[27]A further complication is the fact that several brands in the sample changed hands during the sample period. Baymont Suites shifted from being a largely independent national brand to part of Wyndham's brand portfolio in 2005; and La Quinta was acquired by Blackstone in 2005, a private equity group. I assume that Baymont hotels were always affiliated with Wyndham. I believe this assumption is innocuous as Baymont accounts for less 1.5% of all Wyndham hotels. I also assume that Blackstone's acquisition did not affect a change in La Quinta's overall strategy. I also make the assumption that the possibility of such transactions had no anticipatory effect on firm behavior.

[28]Quality averages are based off of ratings in the 2001, 2002, 2005, and 2006 AAA guides for the sample markets. Individual hotels' qualities range from 0 (in rare instances) to 5 (also rare) stars. Sub-brands that do not appear in the AAA data are set to 3 stars.

[29]I have experimented with more narrow conceptions of the high-quality segment and found qualitatively similar results.

Table 4.1: Number of market-year observations of different brands' hotels

	Quality Tier		
	<2 Stars	≥ 2 Stars	Total
Accor	232	26	258
AmericInn International	0	6	6
America's Best Franchising	0	15	15
Budget Host	30	0	30
Candlewood Hotel Company	0	1	1
Carlson Hotels Worldwide	0	26	26
Choice Hotels	0	595	595
Continent	0	424	424
Drury Hotels	0	2	2
Extended Stay Hotels	0	23	23
Hilton Hotels Corpora	0	213	213
Hyatt	7	23	30
La Quinta	0	209	209
Marriott International	0	161	161
Starwood Hotels and Resorts	0	13	13
Vantage	0	86	86
Wyndham	1	877	878
Independents	3,442	874	4,316
Total	3,712	3,574	7,286

The data indicate that the hotels in the low quality tier are almost all independents with no national brand affiliation, and that almost all independents are low-quality. Therefore, in my empirical analysis, I focus on brands with substantial operations in the 2-3 star segment in Texas (defined as having at least 150 such hotel-year observations), and assume that the hotels associated with smaller networks do not benefit from the same brand reputation effects as those affiliated with the large brands. Instead, consumers view them as analogous to independents.[30] These restrictions leave six different large brands: Choice Hotels, Continent Hotels, Hilton Hotels, La Quinta Inns and Suites, Marriott International, and Wyndham, which together account for 2,479 hotel-year observations (34 percent of the sample and 92 percent of all branded hotels in the sample markets). Table 4.2 shows the sub-brands affiliated with each brand in the sample and their average quality rating.

In keeping with the theoretical model presented above, I start by treating all hotels affiliated with a brand as identical and then relax the assumption to account for differences in sub-brand affiliation.[31] Thus, for each brand j in market m in period t, I count the number of unique name-address pairings affiliated with that brand to determine the size of its portfolio, $\omega_{j,m,t}$. If brand j has not yet entered a market, $\omega_{j,m,t} = 0$. Alterations to brands' portfolios are defined as the net change in the number of unique name-address pairings from one period to the next, i.e. $\omega_{j,m,t} - \omega_{j,m,t-1}$.

Table 4.3 shows the total amount and frequency of changes to portfolio size for entrants and incumbents, and indicates a modest amount of change in market structure over time. Assuming that each of the large brands has the option to change its portfolio in any of the markets in any period, they chose to do so on average

[30] As discussed further below, I experimented with other ways of categorizing hotels with little impact on the results.

[31] I maintain the assumption that hotels within a market are of identical size. This can be justified by examining the average coefficient of variation of capacity in hotels across markets. I find that the average is a modest 18.

Table 4.2: Sub-Brands Affiliated with each Brand

Brand	Sub-Brand	Observations	Average Rating
Choice Hotels	Clarion Inns & Suites	13	2.33
	Comfort Inn	181	2.68
	Comfort Suites	109	3.00
	Econo Lodge	151	2.05
	Quality Inns & Suites	98	2.42
	Rodeway Inn	21	2.00
	Sleep Inn	22	2.00
Continent Hotels	Candlewood Suites	7	3.00
	Crowne Plaza	1	3.00
	Holiday Inn	107	2.97
	Holiday Inn Express	307	2.98
	Staybridge Suites	2	3.00
Hilton Hotels	Embassy Suites Hotels	10	3.00
	Hampton Inn	172	3.00
	Hilton	9	2.85
	Hilton Garden Inn	2	3.00
	Homewood Suites by Hilton	20	3.00
La Quinta	La Quinta Inns	209	2.93
Marriott International	Courtyard	34	2.88
	Fairfield Inn	81	2.81
	Residence Inn	31	3.00
	Ritz-Carlton	3	3.00
	Springhill Suites	3	3.00
	Towneplace Suites	9	3.00
Wyndham	Baymont Inn & Suites	11	3.00
	Days Inn Worldwide	370	2.19
	Hawthorn Suites	3	3.00
	Johnson International	62	2.24
	Ramada	151	2.24
	Super 8 Motels	230	2.06
	Travelodge Hotels	42	2.42
	Wingate	8	3.00

Table 4.3: Portfolio Changes

Change in Portfolio	Incumbents	Entrants	Total
-2	1		1
	0.07		0.01
-1	68		68
	4.67		0.77
0	1,290	7,234	8,524
	88.66	98.7	97.04
1	87	95	182
	5.98	1.3	2.07
2	8	0	8
	0.55	0	0.09
3	1	0	1
	0.07	0	0.01
Total	1,455	7,329	8,784
	100	100	100

Notes: The top row in a cell indicates the number of observations, while the second indicates the percentage of that column's observations.

only 3 percent of the time. This makes sense as demand conditions in hotel markets evolve slowly, and there are substantial sunk costs involved. Of the 258 brand-period observations in which a brand altered the size of its portfolio of hotels, only 10 of the changes are greater than 1 in absolute value. For this reason, in the empirical analysis, I topcode those that are greater than 1 to 1 and those that are less than -1 to -1.

There are 7,091 different market-period-taxpayer observations, indicating that there are few instances of taxpayers owning more than one hotel in a given market. Of these, 2,404 include at least one hotel affiliated with the six large brands. Of the 165 cases in which a taxpayer is associated with two or more hotels in a single market, 73 have at least two branded hotels, and 48 are affiliated with two or more different brands.

4.4 Dynamic Analysis

4.4.1 Econometric Approach

As elegantly argued in Eaton and Lipsey (1979), when spatial preemption is credible, the break-even point in time for introducing a new hotel for an incumbent occurs *prior* to when it occurs for a potential entrant. Thus, if incumbents are engaging in entry-deterrence, it can be detected by observing a higher likelihood of expansion by incumbent brands rather than entry by brands with no hotels currently in the market *ceteris paribus*. This is straightforwardly operationalized empirically by estimating and comparing the conditional choice probabilities of entry and expansion. My baseline empirical approach is to estimate these things separately, using ordered logit models to capture the decisions of incumbents and binary logit models for potential entrants. As a robustness check, I estimate the two in tandem conditional on at least one firm having decided to expand.[32] In all cases, the dependent variable is the change in the brand's market portfolio size between time t and time $t+1$, i.e. $\Delta\omega_{j,m,t+1}$, while the regressors are evaluated at time t.

Throughout the empirical analysis, I assume that each brand is a decision-maker who can modify its portfolio in each market every period, and that a brand's decision to alter its portfolio in one market does not affect the likelihood of changes to any other market. This assumes away the network externalities considered in recent work (e.g. Jia (2008)), which is reasonable here given the substantial distance between markets. Moreover, sub-sample analyses using markets even farther apart yielded

[32]Ideally, I would estimate a dynamic structural model of entry and exit by the different brands (see Ackerberg et al. (2005) for a recent survey of these methods). This would maximize efficiency by estimating entry and expansion decisions simultaneously. Unfortunately, several factors make a structural approach infeasible. First, and most problematic, unobserved heterogeneity across markets is very important. This means that the state space would be too large to make structural estimation feasible. Second, brands' behavior appear to be non-stationary. In other words, adjustment behavior seems to change non-monotonically over time. This would also inflate the size of the state space to be considered. Third, I observe only a modest amount of variation in market structures over time, which would increase the importance of parametric assumptions.

similar results.[33]

The theoretical model in Section 2 highlights several factors that should affect the different conditional choice probabilities. First, the likelihood of adding a new hotel should be negatively related to the number of branded hotels already in the market regardless of the brands they are affiliated with. However, the model implies effects of different magnitudes depending on whether the hotels already in the market are affiliated with the decision-maker or not. Therefore, if I am analyzing the behavior of brand j, I proxy for the intensity of competition using the number of hotels belonging to the decision-making brand, $\omega_{j,m,t}$ and the sum of hotels belonging to other brands, i.e. $\sum_{i \neq j} \omega_{i,m,t}$.[34] If an additional hotel affiliated with a different brand has a *smaller* negative impact than an additional hotel in the brand's own portfolio, this is consistent with the presence of brand-effects which make intra-brand competition more intense than inter-brand competition. It suggests that consumers are so heavily affected by branding that it is more unprofitable to expand than to accept entry by a competitor.

Second, the model suggests that firms with higher brand-values or more distinct sub-brands should be better able to engage in preemption. I assess this possibility through the inclusion of brand fixed effects in some specifications.[35] In the following section, however, I exploit the presence of revenue information in my data to investigate the role of sub-brands in greater detail.

In order to control for heterogeneity across markets, I include each market's pop-

[33]These results are available upon request.

[34]I experimented with more detailed market structure descriptions, but did not find that doing so altered the results. In particular, I experimented with separating the total number of independents into the number of high and low quality independents. The results were essentially unchanged. I also experimented with other representations of the portfolios of competing brands, including the number of hotels affiliated with the dominant competitor. Again, the results were qualitatively the same. Details are available upon request.

[35]Examination of *Brandweek* suggests that abstracting from intertemporal variation in brand-values is a reasonable assumption as the relative ranking of different hotel brands appears comparatively time-invariant. Moreover, recent research by Clark et al. (2009) suggests that advertising has little effect (at least in the short term) on consumers' quality impressions.

ulation (in thousands) using U.S. Census data and the average household income (in thousands) taken from the Statistics of Income (SOI) collected by the Internal Revenue Service.[36] I also include the number of "independent" hotels as a control. Past research (e.g. Kalnins and Chung (2004)) has suggested that hotel segments are sufficiently differentiated as to not compete with each other. Instead, there may be inter-segment agglomeration economies. To control for changes in the macroeconomic environment, I include year fixed effects in all regressions.

My baseline empirical models thus have the following form:

$$\Delta\omega_{j,m,t+1}* \quad = \quad \beta_1\omega_{j,m,t} + \beta_2 \sum_{i \neq j} \omega_{i,m,t} + X'_{j,m,t}\lambda + \epsilon_{j,m,t} \tag{4.5}$$

where $\Delta\omega*$ is a latent utility variable indicating the desired modification to the current portfolio of brand j in market m at time t, $X_{j,m,t}$ is a vector of controls, and $\epsilon_{j,m,t}$ an independent draw from an extreme value distribution. As $\Delta\omega*$ increases, the firm will choose higher ordered outcomes as it crosses unobservable (but estimable) cutpoints (see Cameron and Trivedi (2005) for details).

The regressions will provide consistent estimates of how the variables capturing the competitive structure of the market affect the likelihood of investment if the markets are fundamentally equivalent after controlling for observable variation in population and average household income. If the demographic controls do not fully capture the profit potential in a given market, however, the coefficients on the market structure variables could be biased. In particular, if some markets are inherently more profitable - due to the presence of a tourist attraction or variation in local land use regulation (see, e.g., Suzuki (2009)) - then it is likely that there will be more competitors in the market and also that the decision-maker will be more likely to increase the size of her

[36]See: http://www.irs.gov/taxstats/article/0,,id=120303,00.html. These data are only available at the county level, so I use the value for the most common county for each city. As the SOI data are only available through 2005, I linearly extrapolate the data for the remaining years.

portfolio. I address this possibility through the use of fixed effects. Unlike random effects, fixed effects may be correlated with the other variables, and thus can control for time invariant unobserved differences in market profitability or costs. However, as first described in Neyman and Scott (1948), the presence of incidental parameters, like fixed effects, in non-linear models can produce biased results (as well as potentially complicating estimation). The consequences for empiricists remain comparatively unexplored. Some Monte Carlo studies suggest that as the length of the panel grows, the problem disappears (e.g. Heckman (1981)) provided no dynamics are involved, though Greene (2004) suggests that it is difficult to generalize. Insofar as I have 8 years of data for each market and more than one observation for most market-periods, I believe that the probability of sizable bias is small.[37] I test this assumption by re-estimating the non-linear models using ordinary least squares (OLS). This is not an ideal test insofar as the dependent variables in the entry/expansion models are discrete while OLS assumes they are continuous. However, as fixed effects in linear models are not subject to the problem of incidental parameters, comparing the non-linear results with OLS results should show whether the logit and ordered logit fixed effects models are generally accurate.

As my regressors are functions of previous values of the dependent variable, the presence of market fixed effects also may reasonably lead to concerns about correlations in the error terms as in dynamic panel estimation (see, e.g., Cameron and Trivedi (2005, chap. 22.5)). I believe the problems are unlikely to be pronounced here as my righthand-side variables are not simple lags of the dependent variable. Moreover, I am including market fixed effects rather than brand-market fixed effects. Nevertheless, as a robustness check, I estimate a linear instrumental variables model using one-period lagged values of the potentially endogenous market structure variables (i.e. the decision-maker's portfolio and the number of branded competitors) as

[37]This assumption is supported by recent work by Collard-Wexler (2009), who finds evidence of only small bias in a pure panel with 12 observations per group.

instruments.

As another form of robustness check, in some models, I include a measure indicating the relative dominance of the brand. This term helps control for the greater complexity of markets in the data relative to the theoretical model. In addition, as formalized in Ellison and Ellison (2007), it is reasonable to expect a non-monotonic relationship between preemptive behavior and the threat of entry by incumbents.[38] To a large extent, I believe the market-specific fixed effects should capture the level of the threat of entry. Nevertheless, as another robustness check, in some regressions I include time varying controls for the threat of entry. Specifically, I use a quadratic function of the difference in size between the largest and smallest portfolios in the market in some regressions. The theoretical model suggests that entry should be most likely when there is a large gap between the incumbents' portfolio size and the potential entrant, so I use this gap as a proxy for the threat of entry.

In all regressions, I employ standard errors clustered at the market level. Clustering at this level allows me to account for the possibility that the decision-makers' choices in markets may be correlated across brands and periods. This reduces the number of degrees of freedom, making it more difficult to find statistically significant results, and hence is a conservative approach.

4.4.2 Empirical Analysis

Table 4.4 shows summary statistics of the variables used in the analysis of changes in brands' portfolios. Consistent with the theoretical model's implication that incumbents should not be able to deter entry, Table 4.5 shows that the vast majority of brands have no more than one hotel in a market. For example, the Table indicates that of the 558 brand-market-observations in markets with two branded hotels, only

[38]This is because if the threat of entry is very low, it is unlikely that the incumbent will wish to incur the cost of deterrence. Similarly, when the probability of entry is very high, then it is unlikely that deterrence will work, making it unappealing. Only when the threat of entry is modest should deterrence be an attractive strategy.

Table 4.4: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Hotels in the portfolio	9,882	0.25	0.68	0.00	8.00
- Choice	1,647	0.36	0.83	0.00	6.00
- Continent	1,647	0.26	0.51	0.00	3.00
- Hilton	1,647	0.13	0.44	0.00	4.00
- La Quinta	1,647	0.13	0.38	0.00	3.00
- Marriott	1,647	0.10	0.48	0.00	4.00
- Wyndham	1,647	0.53	1.05	0.00	8.00
Other Brand Networks' hotels	9,882	1.25	2.66	0.00	23.00
Independent hotels	9,882	2.92	3.88	0.00	28.00
Population ('000s)	9,882	14.28	29.85	0.96	223.18
Income ('000s)	9,882	41.39	9.41	18.57	93.61
Share of Branded Portfolios	1,675	0.05	0.13	0.00	0.71
Changes to Portfolios	8,784	0.01	0.18	-2.00	3.00
Total Number of Branded hotels	9,882	1.51	3.15	0.00	25.00
Entry Threat	9,882	0.69	1.10	0.00	8.00

14 (i.e. 2.5 percent) are for brands controlling all of the branded hotels in the market.

4.4.2.1 Expansion by Incumbents

Table 4.6 reveals how incumbent brands (i.e. those with at least one affiliated hotel in a market) change their portfolios as a function of their own current portfolio size, the number of hotels affiliated with the other five brands, the number of independents, and local demographic conditions. In this case, the left-hand side of (4.5) for each decision-maker is -1, 0, or 1. Table 4.7 indicates the average effect of a marginal change in the different independent variables on the probabilities of the different outcomes for the non-linear regressions.[39]

Column 1 shows the results of my baseline estimation of incumbents' decision-making. $cut1$ and $cut2$ represent the two threshold parameters between the different ordered outcomes. A joint test that all of the market effects are equal to 0 is rejected

[39]I follow Cameron and Trivedi (2005) in presenting average effects of a small change rather than marginal effects calculated at the mean of the explanatory variables.

Table 4.5: Market Structure and Market Size

	Portfolio Size				
Total Branded	0	1	2	3	Total
2	386	158	14	0	558
	69.18	28.32	2.51	0	100
3	232	157	25	0	414
	56.04	37.92	6.04	0	100
4	178	134	52	2	366
	48.63	36.61	14.21	0.55	100
5	147	162	54	15	378
	38.89	42.86	14.29	3.97	100
6	34	76	22	6	138
	24.64	55.07	15.94	4.35	100
7	35	83	26	18	162
	21.6	51.23	16.05	11.11	100

Notes: The table shows the relationship between the total number of hotels affiliated with the large national brands and the size of individual brands' portfolios. The top row in a cell indicates the number of observations, while the second indicates the percentage of that row's observations.

at the 1 percent level.[40] Table 4.7 indicates that one additional unit in the brand's own portfolio is associated with an almost 6 percent decrease in the likelihood of expanding. By contrast, an additional branded competitor translates to a reduced likelihood of expansion of just 3.3 percent. The difference between the two coefficients is statistically significant at the 1 percent level, and is inconsistent with large incumbents preempting smaller ones. Overall, the results indicate that larger players are less likely to expand than their smaller competitors, which is consistent with the theoretical model's prediction that when branding plays a large role in consumers' decision-making, market share will be evenly distributed.

The finding that large incumbents are less likely to open new hotels than smaller ones is robust across specifications. In column 2, I control more explicitly for brands' share of the market, and find a negative, albeit statistically insignificant, relationship

[40]This is also true for all subsequent regressions involving market effects.

Table 4.6: Alterations to Incumbent Brand Network's Portfolios

	(1)	(2)	(3)	(4)
Hotels in the Portfolio	-1.052***	-1.047***	-0.939***	-1.375***
	0.227	0.23	0.235	0.296
Other Branded Hotels	-0.599***	-0.602***	-0.500***	-0.473***
	0.16	0.173	0.171	0.179
Independent Hotels	0.124	0.125	0.004	0.042
	0.115	0.118	0.126	0.136
Population ('000s)	0.168***	0.169***	0.189***	0.202***
	0.058	0.061	0.062	0.064
Income ('000s)	-0.008	-0.008	0.014	0.021
	0.049	0.049	0.058	0.06
Share of Branded		-0.074	0.021	-1.101
		1.08	1.061	1.211
Entry Threat			-1.180*	-1.102*
			0.643	0.638
(Entry Threat)^2			0.109	0.105
			0.141	0.143
Continent				-1.816***
				0.307
Hilton				-1.394***
				0.305
La Quinta				-1.709***
				0.312
Marriott				-0.934**
				0.431
Wyndham				-0.011
				0.367
cut1	9.628*	9.692	9.324	9.923
	5.6	5.922	5.884	6.035
cut2	16.129***	16.192***	15.871***	16.781***
	5.743	6.061	6.033	6.204
Year Fixed Effects	Yes	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes	Yes
Observations	1455	1455	1455	1455
Number of Markets	87	87	87	87
Log Likelihood	-553.916	-553.913	-550.839	-528.329

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors clustered at the market level are below coefficients.

between market share and the likelihood of expansion.[41] Column 3 adds time-varying controls for the threat of entry. The results indicate that controlling more explicitly for the threat of entry does not change the result that brands are not engaging in entry deterrence. Instead, they further emphasize concerns about cannibalization as the negative and significant coefficient on the linear term is consistent with the inability of incumbents to deter entry or expansion by smaller competitors.

In column 4, I control for the possibility that the results are driven by heterogeneity in the different brands by including dummy variables for each brand. A test that these dummy variables are jointly indistinguishable from 0 is rejected at the 1 percent level of statistical significance, indicating that there are significant behavioral differences across the brands. After controlling for this heterogeneity, the estimated difference between the impact of hotels affiliated with the decision-maker and all others actually increases. Moreover, the coefficients on the different brand fixed effects appear intuitive. They indicate that Choice (the excluded category) and Wyndham are most likely to expand. As can be seen in Table 4.2, these firms' affiliated brands are quite dispersed in name and frequency. This dispersion may decrease the cannibalization problem caused by adding an additional hotel. Thus, an increased likelihood of expansion would be expected. Marriott also has a number of prominent sub-brands with distinctly different names, but is much less likely to expand. This may be reconciled by noting that the Marriott logo tends to feature prominently in the signage of all affiliated brands, and the brand has a very well-established loyalty program. Both factors could lead to more intense brand-valuations that would increase cannibalization effects, leading to lower expansion rates.

The findings on the control variables are broadly intuitive and consistent across specifications. In line with the cross-segment agglomeration effects found in Kalnins

[41] In subsample analyses, I also found results consistent with the idea that incumbency or monopoly control over a market does not confer the ability to defend market power. The result of these models are available upon request.

Table 4.7: Estimated Mean Marginal Effects in Independent Variables

Change in Portfolio	Variables	(1)	(2)	(3)	(4)
	Hotels in the Portfolio	0.045	0.045	0.040	0.057
	Other Branded Hotels	0.025	0.026	0.021	0.019
	Independent Hotels	-0.005	-0.005	0.000	-0.002
-1	Population ('000s)	-0.007	-0.007	-0.008	-0.008
	Income ('000s)	0.000	0.000	-0.001	-0.001
	Share of Branded		0.003	-0.001	0.046
	Entry Threat			0.050	0.046
	(Entry Threat)^2			-0.005	-0.004
	Hotels in the Portfolio	0.014	0.014	0.013	0.018
	Other Branded Hotels	0.008	0.008	0.007	0.006
	Independent Hotels	-0.002	-0.002	0.000	-0.001
0	Population ('000s)	-0.003	-0.003	-0.003	-0.004
	Income ('000s)	0.000	0.000	0.000	0.000
	Share of Branded		0.001	0.000	0.014
	Entry Threat			0.017	0.014
	(Entry Threat)^2			-0.002	-0.001
	Hotels in the Portfolio	-0.059	-0.059	-0.053	-0.075
	Other Branded Hotels	-0.033	-0.033	-0.028	-0.025
	Independent Hotels	0.007	0.007	0.000	0.002
1	Population ('000s)	0.010	0.010	0.011	0.012
	Income ('000s)	-0.001	0.000	0.001	0.001
	Share of Branded		-0.004	0.001	-0.060
	Entry Threat			-0.067	-0.060
	(Entry Threat)^2			0.006	0.006

and Chung (2004), the number of independent hotels is positively correlated (albeit statistically insignificantly and of small economic magnitude) with the likelihood of expansion. Population has a positive and significant effect, indicating that growing markets are more likely to see expansion by incumbent brands. Household income, however, is economically and statistically insignificant.

Table 4.8 shows the results of robustness checks. Column 1 indicates what happens when the market fixed effects are omitted from the ordered logit models. The results indicate a smaller, but still negative and significant effect, for the number of hotels in the brand's portfolio, and a positive, albeit statistically and economically insignificant, correlation between the likelihood that an additional hotel is opened in the next period and the number of branded competitors. Both differences from my baseline results are consistent with the presence of unobserved profitability differences that lead to higher levels of concentration in some markets, indicating that the market controls are necessary. Column 2 estimates the OLS analogue to Column 4 of Table 4.6. The coefficients are all consistent in sign and comparative magnitudes to those of the non-linear models' marginal effects. The marginal effects of the market structure variables, however, are about twice as large in the OLS models as in the ordered logit regressions.[42] The results of the regression that uses lagged values of the market structure variables as instruments for the current market structure are presented in Column 3. They are extremely similar though they yield less precise estimates.[43]

[42]Given the very different assumptions underpinning the different models, I do not find this difference particularly concerning. However, in future work, I plan to explore whether it is consistent with the presence of incidental parameters bias as in Greene (2004).

[43]My results are also robust to re-parameterizations where market structure is controlled for using shares of all hotels in the market, sub-sample analysis of just small markets (as proxied by the number of hotels there), including a dummy indicating that the decision-maker is a monopolist, and using more isolated markets (i.e. where the markets are at least 20 miles apart as previously defined). Results for these models are available upon request.

Table 4.8: Incumbent Expansion Robustness Results

	(1)	(2)	(3)
Hotels in the Portfolio	-0.363***	-0.137***	-0.137*
	0.111	0.028	0.072
Other Branded Hotels	0.013	-0.053**	-0.074
	0.019	0.02	0.067
Independent Hotels	0.024	0.005	-0.001
	0.042	0.015	0.019
Population ('000s)	0.008	0.020***	0.023*
	0.005	0.007	0.014
Income ('000s)	0.009	0.002	0.002
	0.01	0.006	0.007
Share of Branded		-0.138	-0.267
		0.117	0.202
Entry Threat		-0.107	-0.124
		0.079	0.108
(Entry Threat)^2		0.012	0.017
		0.017	0.019
Continent		-0.163***	-0.145***
		0.031	0.031
Hilton		-0.124***	-0.109***
		0.034	0.038
La Quinta		-0.161***	-0.140***
		0.037	0.038
Marriott		-0.096**	-0.067
		0.047	0.052
Wyndham		0.003	-0.001
		0.035	0.036
cut1	-3.032***		
	0.42		
cut2	2.998***		
	0.404		
Constant		-1.267*	-1.495
		0.656	1.172
Year Fixed Effects	Yes	Yes	Yes
Market Fixed Effects	No	Yes	Yes
Observations	1455	1455	1298
Number of Markets	87	87	87
Log Likelihood	-593.718	-378.837	

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors clustered at the market level are below coefficients.

4.4.2.2 Market Entry

Table 4.9 presents the results, and Table 4.10 shows associated mean marginal effects, for empirical analyses of potential entrants' decisions. As noted above, potential entrants are defined as brands that do not yet have an affiliated hotel in the market. Thus, the left-hand side of (4.5) for each decision-maker is just 0 or 1.

Table 4.9: Models of Potential Entrants' Decisions

	(1)	(2)	(3)	(4)
Other branded hotels	-1.828***	-2.104***	-1.916***	-0.058***
	0.384	0.575	0.636	0.015
Independent hotels	0.024	-0.247	-0.181	-0.002
	0.235	0.262	0.293	0.005
Population ('000s)	0.772***	0.610*	0.525*	0.025***
	0.266	0.338	0.312	0.005
Income ('000s)	0.084	0.073	0.087	0.001
	0.16	0.102	0.093	0.001
Entry Threat		-3.656***	-3.936***	-0.016
		1.031	1.141	0.02
(Entry Threat)^2		1.201***	1.164***	0.015
		0.371	0.416	0.01
Continent			0.754	0.012**
			0.478	0.005
Hilton			-0.945*	-0.006
			0.536	0.004
La Quinta			-1.176**	-0.008**
			0.511	0.004
Marriott			-3.612***	-0.019***
			0.88	0.004
Wyndham			0.612	0.005
			0.516	0.005
Constant	-70.726**	3.69E+07	-1.54E+07	-1.894***
	28.097	6.62E+07	6.62E+07	0.539
Year Fixed Effects	Yes	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes	Yes
Observations	2064	2064	2064	7329
Number of Markets	65	65	65	180
Log Likelihood	-312.827	-316.372	-275.912	6034.409

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors clustered at the market level are below coefficients.

Column 1 of Table 4.9 shows the results of a logit model with market fixed effects. The results imply, as expected, that more intense competition is correlated with a lower likelihood of entry.[44] A large number of observations are lost due to the fact that in some markets the entry decision is perfectly determined by the market fixed effect. The results for the other variables are also all broadly consistent in sign, significance, and rough magnitude with those found in Table 4.6. Column 2 shows that these results are robust to controlling for the threat of entry.[45] Column 3 includes brand-specific dummy variables; again, the results are broadly consistent with what was previously observed. Column 4 estimates the same specification using OLS; the qualitative findings in the previous columns are robust to the inclusion of the dropped markets. However, as in the regressions of incumbent brands' decisions, the marginal effects are slightly different between the logit and OLS models. In this case, the OLS coefficient is slightly *smaller* for the number of competitors already present. Interestingly, while the coefficients are quite similar in the OLS models of entry and expansion, the marginal effects of the logit and ordered logit models are moderately different for the effect of the number of other competitors. Overall, I think the broad similarity of the magnitudes of the estimates in the expansion and entry models is an indication of the robustness of the approach.

4.4.2.3 Comparing Entry to Expansion

Insight into how market structure affects the likelihood of expansion versus entry can be gained by looking at the marginal effects of changes in the market structure on the likelihood of expansion versus entry holding all factors constant, including the

[44] As before, omitting market effects leads to a spuriously positive correlation between competition and entry. These results are available upon request.

[45] These results also control for the fact that a negative sign on the number of other branded hotels in the market could be consistent with preemption insofar as it might indicate that an entrant would not enter a market where a single incumbent had a large presence. I am grateful to Uday Rajan for pointing out this possibility.

Table 4.10: Estimated Mean Marginal Effects of Marginal Change in Independent Variables

	(1)	(2)	(3)
Other branded hotels	-0.071	-0.079	-0.065
Independent hotels	0.001	-0.009	-0.006
Population ('000s)	0.029	0.022	0.017
Income ('000s)	0.003	0.003	0.003
Entry Threat		-0.138	-0.133
(Entry Threat)^2		0.045	0.039

unobserved market heterogeneity.[46] I provide one example of this approach in Figure 4.4, which shows the relative likelihood of expansion versus entry as a function of market structure. The X-axis indicates the number of branded hotels in the market. For the incumbent, I assume these are all affiliated with its brand. For the entrant, they are all competitors. The other variables are arbitrarily set at the level for the market of Nacogdoches in 2002. The predictions are based on estimation (1) of Table 4.6 and estimation (1) of Table 4.9.[47] Consistent with the simple description above, the Figure shows that the likelihood of expansion is substantially lower than the likelihood of entry for all values of the number of hotels in the market.[48]

Obviously, this is simply one market, which makes generalization difficult. A less arbitrary and more comprehensive way to test for preemption that explicitly accounts for differences in the mean likelihoods is to compare the predicted likelihood of expansion by incumbents to the predicted likelihood of entry by potential entrants holding market structure constant. For the 392 market-periods where some but not all brands are present, meaning that both entry and expansion are possible, the mean likelihood of expansion is 4.54 percent (using estimation (1) of Table 4.6), while the

[46] One cannot simply focus on the estimated mean marginal effects due to the fact that the models have different baseline likelihoods since the market fixed effects are not the same.

[47] In 2002, Nacogdoches had 6 independents, a population slightly in excess of 30,000, and an average household income of $40,700. It supported a total of six branded hotels.

[48] While Figure 4.4 is generally indicative of the data, it is worth noting that there are some markets where differences in the values of the market-effects are such that the probability of entry or expansion are both essentially zero, with the likelihood of entry slightly lower.

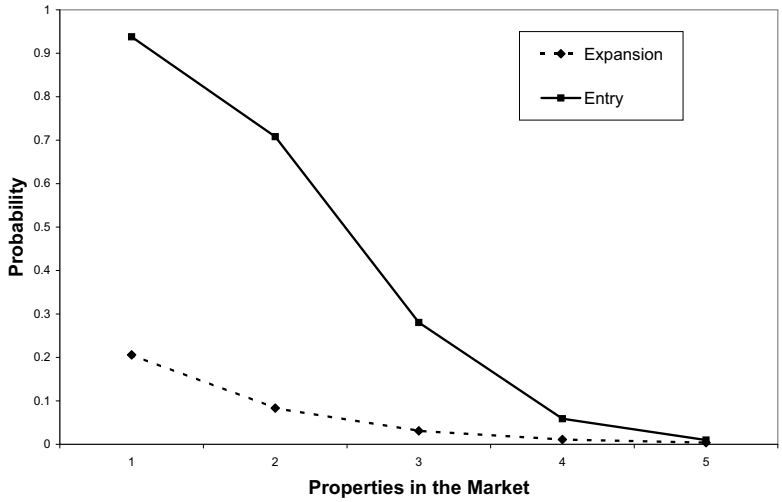

Figure 4.4: Likelihood of entry versus expansion in Nacogdoches

mean likelihood of entry is 6.84 percent (using estimation (1) of Table 4.9). Thus, the likelihood of entry is over 2 percentage points higher (i.e. almost 51 percent higher), and the difference between the two series is statistically significant at the 1 percent level.[49]

To further probe the relative likelihood of entry versus I estimate binary logits (and a linear probability model) of the decision to add a hotel conditional on the fact that at least one property is added to the market between periods.[50] This approach has the benefit of constraining the different control variables to symmetrically impact entrants and incumbents, and reduces the likelihood that the need to separately estimate coefficients that should be identical will lead to noisy estimates. However, it

[49]There are 392 observations, and the standard errors for the propensity to expand and enter are 0.044 and 0.099, respectively.

[50]Specifically, I focus on those markets where at least one new branded hotel was added to the market, and no incumbent chose to reduce its portfolio. This limitation was implemented to make it as reasonable as possible to reduce the left-hand side to a binary choice for both entrants and incumbents. There were 25 market-years where two or three new hotels opened.

Table 4.11: Models of Conditional Addition Decisions

	(1)	(2)	(3)
Entrant Dummy	0.613*	1.064**	0.163**
	0.353	0.433	0.062
Hotels in the Portfolio	-0.023	-0.306	-0.043
	0.192	0.227	0.041
Other branded hotels	-0.111	-0.054	-0.008
	0.124	0.143	0.025
Independent hotels	-0.064	-0.082	-0.013
	0.087	0.094	0.017
Population ('000s)	-0.032	-0.048	-0.007
	0.037	0.042	0.007
Income ('000s)	0.015	0.015	0.003
	0.023	0.026	0.004
Continent		-0.096	-0.007
		0.351	0.067
Hilton		-0.930**	-0.152**
		0.37	0.06
La Quinta		-2.094***	-0.265***
		0.525	0.06
Marriott		-2.209***	-0.287***
		0.654	0.068
Wyndham		0.27	0.039
		0.355	0.069
Constant	3.713	6.426*	1.373**
	3.312	3.783	0.622
Year Fixed Effects	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes
Observations	762	762	762
Number of Markets	72	72	72
Log Likelihood	-376.632	-340.001	-344.343

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors clustered at the market level are below coefficients.

has the drawback of dramatically reducing the sample to just those market-periods where either entry or expansion took place. Thus, there is less data with which to identify the effects.

Table 4.11 shows the results of these regressions, while Table 4.12 shows the mean marginal impact of changes in the independent variables. Consistent with what I found using the predicted likelihoods, the models indicate that entrants are much more likely to account for the new hotels in these markets. An entrant is 10-20 percent more likely to increase its portfolio than an incumbent with one property, depending on the specification. When brand fixed effects are employed, I find, as before and consistent with the theoretical model, that large incumbents are least likely to expand. The difference between the coefficients on the number of hotels in a firm's portfolio and its competitors' is statistically significant. Appealingly, the same general patterns in the firm fixed effects recur. As before, Wyndham and Choice are much more likely to account for the new hotels. Marriott, which has a particularly developed loyalty program and aggressive branding, and La Quinta, which only has one sub-brand, are the least likely.

In all of the regressions, none of the control variables are statistically or economically significant. This is not surprising given that I am already conditioning on the fact that entry and/or expansion will take place.

Overall, the data support the theoretical model's prediction that in an industry – like lodging – where branding is a key driver of consumers' choices, it will be difficult to sustain spatial preemption, as entry is more likely than expansion.

Table 4.12: Estimated Mean Marginal Effects of Marginal Change in Independent Variables

	(1)	(2)
Entrant Dummy*	0.096	0.150
Hotels in the Portfolio	-0.004	-0.044
Other branded hotels	-0.018	-0.008
Independent hotels	-0.010	-0.012
Population ('000s)	-0.005	-0.007
Income ('000s)	0.002	0.002

* Effect of Entrant Dummy calculated by taking the mean of the differences between predicted likelihoods when the dummy is equal to 1 and when it is set equal to 0.

4.5 Extensions

4.5.1 Hotel Revenue Regressions

The theoretical model presented above predicts that brands do not engage in spatial preemption because the prominence of branding means that the cannibalization effect dominates tougher competition with unaffiliated hotels. This can be tested empirically by regressing individual hotels' revenues on the same market structure variables as in the previous section. Holding demand conditions constant, a hotel's revenue should fall with the number of both affiliated and competing hotels. However, the presence of an affiliated hotel should have a larger negative effect if the cannibalization effect is pronounced. Thus, my baseline estimating equation in this section has the following form:

$$R_{k,j,m,t} = \beta_1(\omega_{j,m,t} - 1) + \beta_2 \sum_{i \neq j} \omega_{i,m,t} + X'_{j,m,t}\lambda + \epsilon_{k,j,m,t},$$

where $R_{k,j,m,t}$ indicates the revenues of specific hotel k affiliated with brand j in market m at time t. As before, X represents a vector of brand, market, and time controls.

I extend this empirical approach to test hypotheses about competition within

brands. As noted above, the cannibalization effect should be reduced if two hotels affiliated with the same brand belong to separate sub-brands. I test this by disaggregating the portfolio associated with a brand into the number of hotels affiliated with the hotel's own sub-brand and the number affiliated with all other sub-brands of the brand. If the sub-brand effect is important, then the magnitude of the coefficient on the number of hotels affiliated with the hotel's own sub-brand should be largest, followed by the coefficient on other hotels affiliated with the same brand, followed by that associated with the number of competing hotels.[51]

I further leverage the revenue data to test Hadfield (1991)'s prediction that under certain conditions incumbents can more successfully engage in entry deterrence by delegating decision-making to highly-incentivized local agents (i.e. franchising). Hadfield (1991) shows that the strategy can succeed because the costs imposed by having to compete with the entrant, while felt in full by a vertically integrated brand, are distributed across the different owners under franchising. Meanwhile, the cost of exiting the market are felt only by each owner. Thus, a spatial preemption strategy will be more credible. I test this hypothesis by looking at the impact on hotel revenues of the extent of vertical separation by its brand-parent in that market. If franchising is associated with successful preemption, we would expect higher (or at least not lower) revenues in markets where ownership is more dispersed.[52] To control for the extent of franchising, I use the ratio of the number of hotels to the number of residual claimants in a brand's portfolio to the fixed effect ordered logit model. This ratio will be higher when the brands' hotels are owned by different parties. Thus, if franchising facilitates spatial preemption, one would expect a non-positive coefficient, because, at worst, more unified ownership should not increase revenues. Otherwise, franchising would not facilitate preemption.

[51] I cannot test the effect of sub-brand differentiation in the dynamic analysis, because there are not enough data to incorporate the choice of sub-brand after deciding to open a new hotel.

[52] As with the impact of sub-brand differentiation, the data do not permit controlling for franchising in the dynamic analysis.

Table 4.13: Summary Statistics for Revenue Regressions

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Log Revenues ('000s)	2479	5.59	0.74	0.98	7.84
Revenues ('000s)	2479	341.59	251.98	2.66	2528.25
Hotels in the Portfolio	2479	1.08	1.47	0.00	7.00
- Same Sub-brand	2479	0.11	0.35	0.00	2.00
- Different Sub-brands	2479	0.97	1.33	0.00	7.00
Other Branded Hotels	2479	13.82	24.71	-1.00	104.00
Independent Hotels	2479	9.72	8.10	0.00	28.00
Population ('000s)	2479	67.99	70.53	1.22	223.18
Income ('000s)	2479	44.62	9.21	22.26	93.61
Hotels : Owners	2479	1.04	0.16	1.00	2.00

Table 4.13 shows the summary statistics for the variables used in the revenue regressions, while Table 4.14 shows the results of OLS regressions of the natural log of hotel revenues (in thousands) on different combinations of market structure variables using a variety of brand and sub-brand fixed effects. As before, in all regressions, I cluster the standard errors at the market level, and employ market and year fixed effects as well as demographic controls.

Overall, the data strongly support the theoretical model. Column 1 includes brand fixed effects, and shows that the presence of a brand-affiliated hotel has an approximately 17.5 times larger negative effect on hotel revenues than a hotel affiliated with a competing brand.[53] In Column 2, I test the sub-brand proliferation prediction, which says that the effect of affiliated hotels with different sub-brands should have smaller negative effects than hotels of the same sub-brand, and find that the data support it. As predicted, the estimated coefficients show that hotel revenues are most negatively affected by the presence of hotels that share both brand and sub-brand effects with it. Sharing just the brand-effect reduces the magnitude by half; being affiliated with another competitor has only one thirtieth the impact. However, the difference between the coefficient on the number of hotels in the same sub-brand

[53]This finding is echoed in other papers in this literature (e.g. Suzuki (2009)).

and the coefficient for the number of all others affiliated with the hotel's brand is not statistically significant. This lack of significance is not surprising given that I only observe a few instances where more than one of a given sub-brand are present in a market in a given period. In Column 3, I replace the brand fixed effects with sub-brand fixed effects, which more fully account for variation within networks. The resulting estimates are again as predicted, though the coefficient on the number of identically sub-branded hotels is no longer statistically significant at conventional levels. Again, I do not find this problematic, given the large number of sub-brand effects that must be estimated.

In Column 4, I test the prediction of Hadfield (1991) that vertical separation can facilitate spatial preemption. Contrary to the prediction, I find that the coefficient on the ratio variable is positive (though a one-tailed test that the coefficient is non-negative is just outside of conventional levels of significance). This result can be rationalized by recognizing that the model in Hadfield (1991) relies on the assumption that the franchisees price at the same level as a vertically integrated firm. If franchisees compete against each other, however, then profits at separately owned hotels will be lower than if the same franchisee owned them both. Hadfield (1991) states that the incumbent can keep their local agents from competing against each other through the use of resale price maintenance. My results suggest that hotel franchisors cannot compel their franchisees to cooperate, which is consistent with what other studies have found for other industries (see, e.g., Thomadsen (2005)).[54]

Overall, these results for the impact of market structure on hotels' revenues are consistent with those in the previous section, and are in line with the model of spatial competition suggested by the theoretical model above. They suggest that hotels affiliated with one brand are close substitutes for each other but poor substitutes for

[54]If franchisors were able to enforce cooperative pricing, it is likely that the issue of encroachment - when a franchisor opens a second franchise in a market - would be less contentious (see, e.g., Blair and Lafontaine (2005)).

Table 4.14: Hotel Revenues

	(1)	(2)	(3)	(4)
Same Sub-brand		-0.127*	-0.106	-0.133*
		0.066	0.07	0.075
Different Sub-brand		-0.064***	-0.072***	-0.064***
		0.022	0.021	0.02
Same Portfolio	-0.070***			
	0.019			
Other Branded Hotels	-0.004**	-0.004**	-0.005***	-0.005***
	0.002	0.002	0.002	0.002
Independent Hotels	-0.01	-0.008	-0.011	-0.008
	0.014	0.014	0.012	0.013
Population ('000s)	-0.006	-0.006	-0.008	-0.007
	0.007	0.007	0.007	0.008
Income ('000s)	0.016**	0.016**	0.015*	0.015*
	0.007	0.007	0.008	0.008
Ratio of Hotels to Owners				0.227
				0.182
Constant	5.679***	5.640***	6.194***	5.837***
	0.775	0.776	0.892	0.983
Year Fixed Effects	Yes	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes	Yes
Sub-brand Fixed Effects	No	No	Yes	Yes
Brand Fixed Effects	Yes	Yes	No	No
Observations	2479	2479	2479	2479
R-squared	0.58	0.58	0.66	0.66
Number of Markets	90	90	90	90

* p<0.10, ** p<0.05, *** p<0.01

Notes: Standard errors clustered at the market level are below coefficients.

competing brands, making it unprofitable to engage in spatial preemption.

4.5.2 Hotel Owner Portfolios

Because lodging franchisees are not contractually inhibited from working with multiple franchisors, I extend the analysis by examining the behavior of hotel owners. Ideally, I would re-estimate the same types of regressions as in Section 4. Unfortunately, due to rapid turnover in the unique taxpayer identification numbers, there are not enough observations to make such an approach possible. Instead, I present Table 4.15, which shows how changes in the number of branded hotels owned by a taxpayer in a given market relate to the number of brands that taxpayer affiliates with in the market. I condition on the fact that the taxpayer already owns at least one branded hotel in the market. There are only a small number of meaningful observations, because there are few changes in market structure, and most taxpayers never have more than one branded hotel in any given market. However, the Table is consistent with what the model predicts: that owners of multiple hotels spread their holdings across networks. For example, all three observations of a local owner choosing to add a new branded hotel to its portfolio in a given market are associated with a partnership with a new franchisor.

Table 4.15: Local Hotel Owner Portfolio Changes

		Δ Networks				
		-2	-1	0	1	Total
-2	1	0	0	0	1	
-1	0	7	2	0	9	
0	0	0	1,779	0	1,779	
1	0	0	0	3	3	
Total	1	7	1,781	3	1,792	

Notes: The Table shows the relationship between the change in the number of brands a given hotel-owner is affiliated with and the number of branded hotels that they own.

I draw further support for the theoretical model's prediction that local hotel owners should be more likely to engage in preemption from other papers considering market power in lodging markets. Using a different period of the CPS data, Conlin and Kadiyali (2006) examine slack capacity as a function of market structure. They find that local owners with large market shares are more likely to have large amounts of slack capacity, which they interpret as evidence in support of entry deterrence. The slack capacity result would be consistent with earlier introduction of new hotels by the incumbents, as predicted by my model.

4.6 Conclusion

The canonical models of spatial preemption suggest that incumbents in differentiated product markets should be able to defend their market power by strategically introducing new offerings into the product space. However, this result has been hard to document in much of the empirical literature. Incorporating insights from the growing structural literature on differentiated product demand into a version of the typical entry-deterrence game, I show that the presence of strong brand preferences inhibits multi-product firms' ability to engage in entry deterrence. This occurs because consumer preferences for specific brands makes intra-firm competition more intense than inter-firm competition, reducing the benefits to preemptive expansion. The model also suggests that in industries where products themselves have strong identities, or fall into different product segments, spatial preemption can more easily be sustained.

I test predictions of the theoretical model using data on hotel operations in Texas from 2000 through 2008. First, consistent with the stylized fact that consumers of lodging are highly affected by branding, I find that the large hotel brands are not engaging in spatial preemption. To the contrary, the data show that incumbent brands on average accommodate expansion by smaller incumbents as well as true entry. In

markets where both entry and expansion by incumbents are possible, I find that, on average, entry is 50 percent more likely. Second, I exploit the presence of revenue information in the Texas data to see if these decisions are consistent with brand affiliation leading to large cannibalization effects. As predicted, the data show a negative monotonic relationship between a hotel's revenues and other hotels' proximity in the product space. Hotels in the same sub-brand have negative effects 1.5 - 2 times larger than hotels from other sub-brands but part of the same brand, which have approximately 10 - 15 times larger negative effects than other competitors. Third, examining the portfolios of local hotel-owners, I find support for the theoretical model's predictions insofar as the data show that when these parties add a new hotel to a local portfolio, they almost always associate it with a new brand.

Overall, the paper's insight into the interplay between demand linkages and entry-deterrence helps to explain why the evidence of entry deterrence is so heterogeneous. For example, it is intuitive that Berry and Waldfogel (2001) observe spatial preemption in radio markets, because stations betray no evidence that they share a common corporate brand. On the other hand, substantial brand effects could explain the lack of preemption that Burton (1994) finds for the insecticide industry. Similarly, research on spatial competition in fast food markets, another industry where consumers' behavior indicates brand loyalty, shows that competition is fiercer between outlets sharing a brand affiliation (e.g. Thomadsen (2005)). My hope is that future work will shed further light on the role branding plays in entry deterrence by exploiting inter-industry and intertemporal variation in the strength of brand preferences. In addition, I believe exploring the reasons for endogenous variation (see, e.g., Sutton (2007)) in the extent to which firms pursue strong brand identities (i.e. the difference between Marriott and Choice) will prove fruitful.

Appendix

In this section, I provide the results of numerical solutions to the theoretical model. In these simulations, I assume that the μ are all drawn from normal distributions with mean 0 and variance σ. I show the relationship between heterogeneous brand preferences and cannibalization by varying the parameters affecting the variance of consumers' heterogeneous brand preferences (σ) and the baseline benefit to staying in one of the hotels in the market (δ). Code for the simulations is written in Matlab 7.8 by the author and is available upon request.

Table 4.16 shows the prices, revenues, and market shares for one hotel under different market structures for different parameter values. The first column of the Table indicates the behavior and payoffs for one hotel in a 2-hotel market where both hotels are affiliated with a single brand. Column two indicates the results for one hotel in a duopolistic market. Column 3 shows the results for one hotel affiliated with a 2-hotel incumbent in 3-hotel markets. Column 4 indicates the results for the entrant in such markets.

As described in the text above, the results show that as the magnitude of σ grows relative to δ, the returns to adding an additional hotel fall for brands. For example, when δ is fixed at 3, the tables show that as σ increases from 0 to 4, the difference between $R^I(2,1)$ and $R^I(1,1)$ falls from 0.28 to 0.19.

Analogous results for markets with the local-owners as decision-makers are available upon request.

Table 4.16: Numerical Results of Theoretical Model for One Hotel Under Different Market Structures

		2 Hotels		3 Hotels	
		Monopoly	Competition	Incumbent	Entrant
$\sigma = 0$ & $\delta = 3$	Price	3.00	1.77	2.04	1.63
	Revenue	1.00	0.77	0.52	0.63
	Mkt Share	0.33	0.44	0.26	0.39
$\sigma = 1$ & $\delta = 3$	Price	3.26	2.16	2.44	2.05
	Revenue	0.94	0.86	0.56	0.75
	Mkt Share	0.29	0.40	0.23	0.37
$\sigma = 2$ & $\delta = 3$	Price	3.93	2.87	3.13	2.78
	Revenue	0.93	0.98	0.61	0.90
	Mkt Share	0.24	0.34	0.19	0.33
$\sigma = 3$ & $\delta = 3$	Price	4.81	3.68	3.92	3.60
	Revenue	0.97	1.12	0.67	1.05
	Mkt Share	0.20	0.30	0.17	0.29
$\sigma = 4$ & $\delta = 3$	Price	5.75	4.53	4.76	4.45
	Revenue	1.05	1.27	0.73	1.22
	Mkt Share	0.18	0.28	0.15	0.27
$\sigma = 5$ & $\delta = 3$	Price	6.73	5.37	5.60	5.33
	Revenue	1.14	1.42	0.80	1.38
	Mkt Share	0.17	0.26	0.14	0.26
$\sigma = 6$ & $\delta = 3$	Price	7.75	6.32	6.54	6.23
	Revenue	1.24	1.60	0.89	1.54
	Mkt Share	0.16	0.25	0.14	0.25
$\sigma = 1$ & $\delta = 2$	Price	2.73	1.95	2.19	1.86
	Revenue	0.67	0.66	0.45	0.58
	Mkt Share	0.25	0.34	0.21	0.31

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